

August, 1958

# The Mining Magazine

VOL. XCIX. No. 2.

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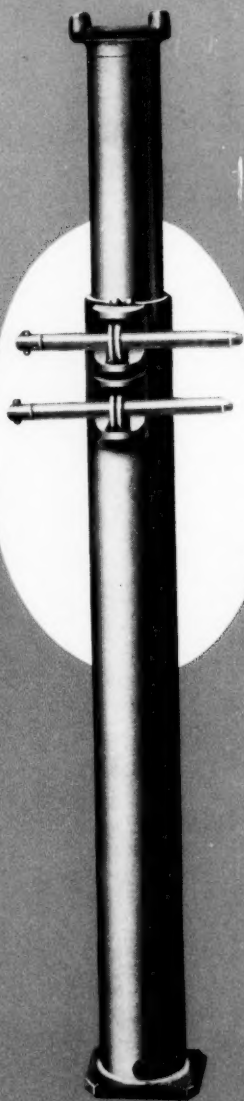


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# The Mining Magazine

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## EDITORIAL

**I**N a recent note issued by the United States Bureau of Mines it is stated that the world production of asbestos was somewhat higher in 1957 than in 1956. While Canadian production as a whole was some 5% more than in 1956 it is interesting to note that British Columbia's contribution to this was no less than 47% higher. Production in the United States reversed a three-year decline by advancing slightly—only 3% over 1956. World output for the year is estimated as 2,070,000 tons, as compared with 1,710,000 in the previous year.

**L**ATER this year the University of Minnesota, in conjunction with the Colorado School of Mines and Pennsylvania State University, is to hold its eighth annual drilling and blasting symposium. In general the discussion will cover recent developments in drilling and blasting practices, problems associated with the use of drilling rods, and drilling and blasting research. Details of papers and registration information may be obtained from the Center for Continuation Study at the University of Minnesota.

**A**S was announced in the June issue the exhibition of mining machinery which is to be held at Olympia, London, in July next year is to be accompanied by a three-day symposium organized by the Institution of Mining Engineers on shaft sinking and tunnelling. It has since been stated that papers for discussion are expected from many countries—notably, France, Germany, Sweden, the United States, and Russia—and all interested are invited to attend. The papers are to be available in advance to those who have registered and forms of application will be obtainable in due course from the Institution. It is certainly to be hoped that there will be a good response.

**A** "METALLOGENIC" map, the first of a series intended by the Geological Survey of Canada to show the distribution of a mineral or minerals, is now available. Entitled "Uranium in Canada," the map shows the distribution of known occurrences classified according to types. Several areas where the geology seems to be favourable are indicated and may be a guide in selecting areas for prospecting and for companies

seeking prospects. The map is printed on transparent paper and can be fitted over the Geological Map of Canada. Marginal notes explain its purpose and scope and list the names of occurrences or areas, the companies or prospectors concerned, the uranium minerals, and gives selected references.

**T**HE Institution of Mining and Metallurgy announces that Dr. J. H. Watson, Chemist and Assayer of the Royal Mint, and a Member of Council of the Institution since 1949, has been made President-Elect for 1959-60. Dr. Watson entered the Royal School of Mines in 1914 but war service soon interrupted his course. He was commissioned in the 7th Division Signal Coy., Royal Engineers and served in France, 1915-17, and in Italy, 1917-19, being mentioned in dispatches and awarded the Military Cross in 1916. Returning to the Royal School of Mines, Dr. Watson obtained the Associateship and B.Sc. degree in metallurgy in 1921. He was awarded the Ph.D. degree at London in 1933. Except for a few months with the Welsh Mines Corporation Dr. Watson has spent all his time at the Royal Mint, which he joined in 1922. He is a Member of the Institute of Metals, of whose London Local Section he was Chairman from 1946 to 1948, serving during that period also as a Member of Council, and a Fellow of the Institution of Metallurgists. Dr. Watson was awarded the M.B.E. for services during the recent war and in 1957 was created C.B.E.

**D**URING the last fortnight of July, under the chairmanship of Dr. F. Dixey, Director of the Directorate of Overseas Geological Surveys in London, the Association of African Geological Surveys held its biennial meeting in Leopoldville, Belgian Congo. Seventy delegates represented 21 official geological surveys as well as the 14 geological surveys belonging to the leading private companies in Africa, lately admitted to the Association. New geological maps of Africa were presented in draft form at the Congress and after discussion their publication was decided. In addition the programme included a symposium on "Uranium in Africa," the essential elements being presented by the representatives of the Commissariat à l'Energie Atomique, of the

United Kingdom Atomic Energy Authority, of the Atomic Energy Board of the Union of South Africa, and of the Union Minière du Haut Katanga respectively. The Association is to continue the publication and the revision of geological maps and is to start the preparation of a metallogenic map and prepare, in view of its next meeting (1960), a synthesis on both the coastal sedimentary basins (of particular interest as regards petroleum) and on copper in Africa.

**S**PEAKING at the annual dinner of the Institution of Mining Engineers held in Birmingham last month the Deputy Chairman of the National Coal Board, Mr. J. Latham, referred to the fact that the Board had found it necessary to impose temporary restrictions on recruitment at many collieries. This, combined with the existence of coal stocks, seemed, he said, to have created an impression that recruits to the industry were not wanted and that there were doubts about its long-term future. However, Mr. Latham said, in several coalfields, particularly those of Yorkshire and the Midlands, a great many recruits were still required. Moreover, throughout the industry they wanted to maintain the flow of boys into the mines and they believed that they could offer better training and better prospects than ever before. The problems of the industry were serious, he said, yet in many ways the present situation was more satisfactory than the old one. There had been little hope of progress in an extractive industry when they could not meet the increasing demand and were compelled to take various kinds of uneconomic measures in their search for coal. Now they had the opportunity to work for increased efficiency and for profitable production.

**I**T is reported from Western Australia that special arrangements are being made for carrying out two geophysical surveys by the Bureau of Mineral Resources of the Department of National Development in the north-west of Australia as part of the Commonwealth Government's contribution to the search for oil. One will be an airborne magnetic survey of about 15,000 sq. miles of the Bonaparte Gulf area by a Bureau DC3 aircraft. Elaborate arrangements are being made for accurate navigation and the aircraft's "Shoran" equipment will be used. This highly accurate electronic system

requires the establishment of a chain of radar beacons on the more prominent points of the terrain over which the plane will be flying. This method of radar navigation enables the position of the plane to be ascertained precisely and its direction of flight maintained constant. When conditions prevent the use of "Shoran" the aircraft will be visually navigated and its position plotted from aerial photographs taken automatically during flights and processed on each return to base. To cover the area by traverses spaced one mile apart will take approximately two months. The other survey is an under-water gravity reconnaissance to be conducted along the Australian coastline from the Gulf of Papua and Torres Strait, past Darwin, and on to Wyndham. This is the first time that the Bureau's new under-water gravity meter will be used since its initial tests some months ago in Port Phillip Bay, Victoria, and the first time any section of the Australian continental shelf will be examined in this way. A 35-ton motor launch has been chartered and the full programme is expected to take seven months to complete, with readings being made approximately every 20 miles over the total course of about 2,500 miles. In certain areas more detailed work will be carried out, with readings being taken every mile, and this is particularly applicable to the search for structures which might favour the accumulation of oil.

### Uranium Search

The search for uranium in Britain and the Overseas Territories has had little publicity until recently, mainly for security reasons, although in September last some details were released regarding airborne surveys in hand for the U.K. Atomic Energy Authority and the Department of Scientific and Industrial Research in Great Britain and Rhodesia.<sup>1</sup> The Department has recently issued some notes dealing with work in hand and from these it appears that the results of a radiometric survey of West and Central Cornwall have so far been interesting, several of the anomalies recorded being sufficiently marked at surface to merit pitting, trenching, and exploratory drilling to prove the extent of the mineralization underground. The area to be covered by airborne survey is to be extended this year to include the remainder of Cornwall, as well as much of Devon and Somerset. In

<sup>1</sup> See THE MINING MAGAZINE, Sept., 1957, p. 160.

addition to this air reconnaissance survey, it is stated, the Atomic Energy Division of the Geological Survey is undertaking the examination of abandoned mine workings in Cornwall, where small amounts of uranium are known to occur, and reconnaissance drilling has now been started. Later, it is believed, the Survey is to expand its activities to cover other areas in which uranium mineralization might occur—for example, North and Central Wales, North England, and the Southern Uplands of Scotland.

The Atomic Energy Division, the youngest branch of the Geological Survey of Great Britain, was created during the Second World War to investigate the exploitation and supply of uranium and other strategic materials and since then it has played an important part in bringing uranium properties into production and in organizing and stimulating the search for the raw materials of atomic energy in many of the countries of the Commonwealth. The Division has, indeed, grown to be a major branch of the Survey and the assistance it can give ranges from radiometric assaying and the preparation of mineralogical reports to field surveys and the assessment of new discoveries of mineralization made by prospectors and mining companies. In 1957, for example, field investigations were carried out in the Union of South Africa, British Guiana, Jamaica, Sierra Leone, Bechuanaland, Ghana, Nigeria, Nyasaland, Southern Rhodesia, and New Zealand, in addition to field work in Britain. In the Division's laboratories thousands of samples are examined annually, while a research programme is maintained which has produced considerable contributions to radiogeology. Studies of importance have been made in the fields of mineralogy and ore genesis, autoradiograph techniques, ore mineral identification, and the examination of radioactive minerals by X-ray methods. To mining companies and private prospectors the Division provides on behalf of the Atomic Energy Authority a free confidential assay service for material considered to be radioactive, the only proviso in accepting material being that full details of locality must be given. The end-product of any such investigation is a report on each specimen or group of specimens submitted which gives details of the uranium or thorium content and the nature of the minerals contributing to the radioactivity, with their grain size and distribution in relation to the associated non-radioactive minerals. Attention is also paid in such

reports to specific problems—such as, the bearing of the mineralogical observations on difficulties that may be encountered in treating material of ore grade. The release of this information is timely; for much of the work carried out by the Geological Survey in this country is too little known by the public it serves.

### Remote Plant Control

A practical demonstration of the fact that a measurement of the performance of equipment in use underground can be indicated remotely was provided in the course of the 117th annual meeting of the Institution of Mining Engineers held last month in Birmingham. At the conclusion of a paper entitled "Colliery Communications Systems," by E. J. Kimmins and B. L. Metcalf, a demonstration was given of a "telemetering decelerometer" in use on tests being carried out on a steam winder installation at Sandwell Park Colliery. The results were relayed to the Imperial Hotel in Birmingham, the audience there seeing traces of velocity and acceleration of the cage in the shaft being drawn on a chart projected on to a screen. For the demonstration the signal from the receiving coil was fed to a G.P.O. amplifier and then through about nine miles of telephone line, including three G.P.O. exchanges, and through a second G.P.O. amplifying unit to the amplifier and receiver unit which was in the lecture hall. The output was then fed to a recorder mounted under an epidiascope so that the trace on the moving chart could be clearly seen on the screen. A further telephone link from the colliery was used to carry a velocity signal from a tachogenerator driven from the winder drum shaft; this was fed through a d.c. amplifier to another channel of the recorder. Thus the acceleration and velocity traces were projected side by side on to the screen. A third telephone link was used as a speech line between the colliery and the lecture hall for the purpose of a commentary.

As the paper included the remote indication and measurement of technical data the demonstration was used to illustrate that measurement of the performance of equipment either in the mine shaft or underground can be remotely indicated wherever necessary. This was the first time that a remote indication of a telemetering decelerometer recording the acceleration and deceleration in a winding rope, which enables the dynamic stresses to be calculated, had been made possible in this country.

## MONTHLY REVIEW

**Introduction.**—Business confidence generally remains steady following the satisfactory gold and dollar reserve figures issued for July. With base-metal prices steady at their present lower levels attention has naturally been directed to the Metals Subsidy Bill recently approved by a Committee of the House of Representatives in Washington. A stockpiling programme would certainly sustain the metal market.

**Transvaal.**—The output of the Witwatersrand and O.F.S. gold mines for June was 1,408,384 oz., making with 39,187 oz. from outside mines a total of 1,447,571 oz. for the month. At June 30 the number of natives employed on the gold mines was 334,882, as compared with 337,464 at the end of May. The estimated working profit for the June quarter has been announced as £24,358,945.

With the report for the June quarter it was announced that VAAL REEFS EXPLORATION AND MINING had initiated preliminary work on the sinking of the new No. 2 shaft system in the southern section of the lease and capital expenditure rose to £466,932 from £198,972. The estimated cost of the system, ancillary buildings, and installations is £5,250,000. The sampled footage averaged 420 in.-dwt., against 398 in.-dwt. in the first quarter.

At June 30 BUFFELSFONTEIN GOLD MINING had completed extensions to its gold plant to a capacity of 160,000 tons a month and nearly completed the conversion of the ventilation shaft to a hoisting unit. An average of 116,000 tons a month was milled in the second quarter; capital expenditure rose to £518,767 from £394,763. It is also stated that the gold plant of STILFONTEIN had been extended to a capacity of 160,000 tons a month. At this mine deepening the Margaret shaft proceeds, where the installation of the Koepe winder is in progress, and preparations for sinking the new Toni shaft are being made. In the second quarter 111,700 tons were milled, capital expenditure increasing to £1,008,856 from £479,773.

It is announced that HARTEBEESTFONTEIN GOLD MINING has repaid a second instalment of £300,000 on its unsecured loan, reducing it to £1,300,000. Capital expenditure in the second quarter increased to £763,384 from £492,005 in the first; shaft sinking continues and extensions to the gold plant are being effected. The balance of the loan

mentioned will be repaid in two annual instalments of £400,000 and one of £500,000.

In a circular issued last month shareholders of WEST WITWATERSRAND AREAS were reminded that to date the activities of the company have been confined to the development of its interests on the "West Wits. Line" and its share investments have been confined to companies operating in that area. The directors now consider that it would be in the interests of members to widen its interests and to extend the spread of its share investments. In pursuance of such a policy it is announced that the company has obtained options to acquire at any time prior to September 30, 1958, the issued share capital of NEW CONSOLIDATED, FREE STATE, EXPLORATION CO., LTD., amounting to £928,125, for a consideration calculated on the basis of two fully-paid shares in West Witwatersrand Areas plus 10s. in cash for every five shares held in New Consolidated, Free State, Exploration. Before the options to acquire the other company can be exercised it will be necessary for the authorized capital of West Witwatersrand Areas to be increased and notice of an extraordinary general meeting to be convened for this purpose is shortly to be sent out, it is stated.

Last month the directors of RUSTENBURG PLATINUM MINES announced that in order to meet competition from other sources the price of platinum sold on behalf of the company has been reduced in the United Kingdom from £25 to £23 5s. and in the United States of America from \$70 to \$65. Market conditions remain weak, it is stated, with no increase in the low level of demand for platinum by the oil companies. Platinum continues to be available from Russian sources. The quantity of platinum sold during the financial year ending August 31, 1958, is likely to approximate to the estimate of 50% of the quantity sold during the previous financial year.

In the June quarter MESSINA (TRANSVAAL) DEVELOPMENT produced 240,473 long tons of ore containing 3,369 tons of copper.

With the report for the three months to June 30 shareholders of WAVERLEY GOLD MINES were informed that good progress has been made with the construction of the new reduction plant at the main shaft and work on the principal unit was sufficiently advanced to permit of milling on a limited scale

taking place. The increase in tonnage milled from 13,805 tons to 16,935 tons during the quarter reflects the operation of the new mill. Construction should be completed during the current quarter with a consequent increase in capacity and efficiency and a reduction in the tailing losses.

**Orange Free State.**—Last month it was announced by FREE STATE SAAIPLAAS GOLD MINING that the Leader Reef was intersected in No. 1 Shaft on July 25 at a depth of 5,387 ft. below collar. The exposure was complete and sampling around the periphery of the shaft showed negligible values. On July 26 the Basal Reef was intersected at 5,394 ft. Again the exposure was complete and sampling around the periphery of the shaft averaged 24.9 dwt. per ton over a reef channel width of 28.2 in., equivalent to 702 in.-dwt.

In the three months to June 30 HARMONY GOLD MINING completed and equipped its No. 2 Shaft to its final depth of 5,535 ft., in the area of which reef development values at 711 in.-dwt. were considerably higher than in the other sections of the mine at 437.4 in.-dwt. The third unit of the gold plant has been installed, increasing the rated capacity to 150,000 tons a month (77,000 tons a month were milled in the second quarter) and the fourth unit, raising the capacity to 200,000 tons a month, will have been installed by early 1960. The uranium plant extensions to 120,000 tons a month are nearly completed and no further extensions are contemplated. The pyrite plant is being enlarged to give an output of 180 tons a day of pyrites, however, and a sulphuric acid plant is to be erected with an output capacity of 120 tons a day. Underground pumping capacity has been increased to 10,000,000 gal. a day and is being expanded further by more installations at No. 2 shaft. Capital expenditure in the quarter rose to £810,400 from £531,400.

**Northern Rhodesia.**—It was announced last month that MUFULIRA COPPER MINES is to employ a firm of specialist contractors to undertake the sinking of the two Prain shafts at Mufulira West. It is stated that the employment of specialist contractors, using novel equipment and techniques in this operation, is dictated by the necessity to sink the Prain shafts at a rate never previously attained in the Federation in order to bring the Mufulira West project into production on schedule. The rapid sinking of the Prain shafts will result in the

employment of about 500 additional Europeans and about 3,000 additional Africans by the Mufulira company some 15 months sooner than if local resources were to be employed at current efficiencies.

The report of NCHANGA CONSOLIDATED COPPER MINES for the year to March 31 last shows a profit of £6,845,380, dividends totalling 10s. a share requiring £3,500,000. In the year 8,544,450 short tons of ore was milled and 21,362 tons of blister and 99,838 tons of electrolytic copper produced. The ore reserves at March 31 last are given as 162,382,000 tons averaging 4.75% copper. The report states that mining operations started at the Nchanga open pit in April, 1957, and, as the tonnage of ore hoisted from underground operations at Nchanga West was virtually the same as for the previous year, the ore won from open-pit mining (393,006 tons averaging 2.79% copper) was mainly responsible for the increase in production during the year to a new record level. In April, 1958, mining began at the Chingola open pit, where 321,000 tons of ore with an average grade of 6.63% copper have so far been exposed.

In a circular issued last month shareholders of RHODESIA-KATANGA CO., LTD., were reminded that in December, 1957, the directors of the KANSANSHI COPPER MINING COMPANY voted £40,000 for research into a proposed integrated process for simultaneous exploitation of both sulphide and oxide ore reserves with production of electrolytic copper by roast-leach techniques. This work, it is stated, is now virtually completed, the results of the small-scale development being most satisfactory. The commercial prospects for the process applied at the Kansanshi site have not yet, however, been assessed, but a preliminary review is to be undertaken immediately by the consultants. If the findings warrant further development of the project a programme of practical continuous pilot operation of the process on a scale to be decided is essential to provide firm estimates of capital and operational costs, since certain metallurgical and engineering features of the process are considered unique.

With the recent dividend notice shareholders of the NORTH CHARTERLAND EXPLORATION CO. (1937) were informed that the profit for 1957 was £9,150. After providing for the dividend, equal to  $8\frac{1}{2}\%$ , and other items there was a balance of £3,106 carried forward.

**Ghana.**—In the course of 1957 BREMANG GOLD DREDGING treated 8,268,300 cu. yd. of ground and recovered 47,253 oz. of gold. Operations resulted in a profit of £70,860, the accounts showing a credit balance of £77,448 carried forward. In his review accompanying the report and accounts the chairman says that following further drilling in the lower section of the Offin River areas, and after taking into account the high cost of installing dredging equipment, it has been decided to abandon certain of the areas on this section of the river as uneconomic for dredging operations. In the year £149,000 was spent on capital and dredge removal account, practically the whole of it on the transfer of the dredges from Ankobra to Jimi/Offin. By the end of 1958 the No. 3 dredge will have completely dredged and exhausted the reserves allocated to it on the Ankobra River and its transfer to the Middle Offin River Areas will be undertaken; the whole operation has been planned to take six months.

**Nigeria.**—With the recent dividend notice shareholders of RIBON VALLEY (NIGERIA) TINFIELDS were informed that operations resulted in a profit of £5,786, making with the sum brought in an available total of £23,014. After providing for the dividend and taxation a balance of £19,671 is carried forward.

**Tanganyika.**—In a progress report to shareholders of KENTAN GOLD AREAS issued at the end of July it is stated in regard to GEITA GOLD MINING and the decision to cease operations that the metallurgical problems encountered during the previous quarter and ascribed to refractory ore from the newly-opened areas were found to be due to oxygen starvation in the agitators. This was immediately rectified; a finer grind was adopted and recovery during June rose above 90%, where it has remained since. In the circumstances plans have been modified and it has been decided to continue operations for a period of two years at a throughput of 18,000 tons a month. This decision is, of course, to be subject to periodical review in the light of the results actually achieved.

In the three months to June 30 URUWIRA MINERALS treated 82,885 metric tons of ore and produced 3,380 tons of concentrates assaying 43.65% lead and 13.03% copper. Operations resulted in an estimated loss of £42,255.

**Angola.**—The accounts of the ANGOLA DIAMOND COMPANY for 1957 show a profit of

Esc. 87,361,780 and Esc. 149,430,983 available. In the year 2,096,253 cu. metres of ground was treated, yielding 0.41 carats of diamond per cu. metre. The report stated that as a result of prospecting operations some new areas have been selected for development works, but that the most interesting results were obtained in the River Cuango basin, where several diamonds of excellent quality were collected. It is probable, it is thought, that the work now in progress in that region may lead to the discovery of not only new evidence of kimberlite but also of secondary deposits. Development operations have enabled the company to include in their reserves two new areas which it is estimated contain approximately 587,000 cu. metres of gravel with about 489,000 carats of diamonds. Soundings in other districts are being made with satisfactory results.

**Australia.**—Shareholders of BROKEN HILL SOUTH were informed last month that in the year to June 30 last the company, in conjunction with BARRIER CENTRAL PTY., treated a total of 339,670 tons of sulphide and sulphated ore, the average grade being 11.7% lead and 11.3% zinc with 7.0 oz. of silver per ton. In the period 51,545 tons of lead concentrate, assaying 72.3% of lead and 41.1 oz. of silver, and 64,882 tons of zinc concentrate assaying 50.7% of zinc were produced.

It was announced earlier this month that INTERSTATE OIL has acquired a 5% interest in HUMBER BARRIER REEF OILS PTY., which was recently incorporated in Queensland and which is controlled by five Canadian interests. In June, 1956, Interstate Oil was granted an option by the ZINC CORPORATION to acquire a one-third interest in rights over an area of 64,500 sq. miles of the Great Barrier Reef. The option lapsed in 1958 following surrender of the area by the Zinc Corporation. The new company has an authority to prospect over the southern portion of the relinquished area and intends to drill a stratigraphic well to test the seaward continuation of sedimentary strata on the Queensland coast.

**New Guinea.**—In the year to May 31 last BULOLO GOLD DREDGING treated 5,456,900 cu. yd. of ground and recovered 23,939 oz. of gold. One dredge, No. 5, and the sluicing equipment were, it is stated, operating in the 1958 period, but No. 5 dredge now has been turned up valley where finally it will dig ground of higher but still moderate value. Two dredges, one digging in high-value gravels, and the sluicing equipment

were operating in the 1957 periods. The plywood operations of Commonwealth-New Guinea Timbers, Ltd., continued normally. The net profit for the year is estimated at \$475,000, which compared with \$966,505 for the previous year.

**Alaska.**—The United States Bureau of Mines recently announced that a report on an investigation of the Hannum lead prospect in the Fairhaven District, Seward Peninsula, has been placed on open file. Included in the report are analyses of representative samples, photographs, sketches, and maps.

**Canada.**—The interim report of the INTERNATIONAL NICKEL CO. of Canada for the six months ended June 30, 1958, shows net earnings in terms of United States currency of \$21,401,000, after all charges, depreciation, depletion, taxes, etc. For the corresponding first six months of 1957 net earnings were \$45,601,000. It is stated that the rate of nickel deliveries in all forms during the first six months of 1958 was down approximately 35% when compared with the same period in 1957, while copper and platinum metals deliveries were also lower. The persisting lower level of demand and a further increase in stocks of unsold nickel have required the company to make a third curtailment this year of nickel production, reducing the annual rate of production as from the middle of July to approximately 200,000,000 lb. of nickel and 200,000,000 lb. of copper.

**United Kingdom.**—At an extraordinary meeting of SOUTH CROFTY, LTD., to be held later this month it is to be proposed that the capital of the company be increased to £250,000 by the creation of 80,000 additional ordinary 5s. shares and 800,000 preferred ordinaries of 2s. 6d. each. It is stated that in order that the operation of the mine may be continued it is essential that shareholders should support these resolutions, which arise out of arrangements which have provisionally been made to raise about £83,000 by the issue of 6½% convertible debenture stock in order to finance the development, expansion, and modernization of the mine. The proceeds of the proposed £83,000 of debenture stock are to be applied as follows: £40,000 for deepening New Cook's Kitchen shaft and associated capital expenditure underground, £20,000 for additions to and further modernization of the crushing and ore-treatment plant, and the balance of £23,000 as working capital.

With the recent dividend notice shareholders of GEEVOR TIN MINES are informed

that the profit for the year to March 31 last, before providing for taxation, is £59,278, which compares with £102,670 for the previous year.

### DIVIDENDS DECLARED

\* Interim † Final.

(Less Tax unless otherwise stated.)

- Aluminium, Ltd.**—Quarterly, 17½ cents, payable Sept. 5.  
**\*Ashanti Goldfields Corporation.**—1s., payable Sept. 12.  
**\*Ayer Hitam Tin Dredging.**—3d., payable Aug. 15.  
**\*Bibiani (1927).**—2.4d., payable Sept. 12.  
**\*Borax (Holdings).**—Deferred Ord., 1.75d., payable Sept. 19.  
**\*Capper Pass and Son.**—3%.  
**\*Consolidated Mines Selection Co.**—1s., payable Aug. 28.  
**†Consolidated Tin Smelters.**—3s. and 6d. bonus, payable Aug. 30.  
**†Ferreira Estate Co.**—9d., payable Aug. 26.  
**†Geevor Tin Mines.**—1s. 3d.  
**\*Gopeng Consolidated.**—3d., payable Aug. 29.  
**International Nickel Co. of Canada.**—Quarterly, 65 cents, payable Sept. 20.  
**†Johannesburg Consolidated Investment Co.**—4s. 6d., payable Sept. 26.  
**\*Konongo Gold Mines.**—2d., payable Sept. 19.  
**\*McIntyre Porcupine Mines.**—50 cents, payable Sept. 2.  
**†Nchanga Consolidated Copper Mines.**—11s. 2.4d., payable Aug. 28.  
**†New Central Witwatersrand Areas.**—3d., payable Aug. 29.  
**†North Charterland Exploration Co. (1937).**—1d., payable Oct. 6.  
**\*Orange Free State Investment Trust.**—1s. 6d., payable Aug. 29.  
**Pahang Consolidated Co.**—Pref. 3½%, payable July 31.  
**†Powell Duffryn.**—10%, payable Oct. 4.  
**†Pusing Rubber and Tin.**—10%  
**†Ribon Valley (Nigeria) Tinfields.**—2½%, payable Sept. 1.  
**\*Sungei Besi Mines.**—7.2d., payable Aug. 13.  
**\*Tanjong Tin Dredging.**—3d., payable July 31.  
**†Tehidy Minerals.**—12½%, payable Aug. 30.  
**†Zaaiplaats Tin Mining.**—1s. 4½d., payable Sept. 5.

### METAL PRICES

Aug. 9.

Aluminium, Antimony, and Nickel per long ton;  
 Chromium per lb.; Platinum per standard oz.;  
 Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home).....	180	0	0
Antimony (Eng. 99%).....	190	0	0
Chromium (98-99%).....	7	2	
Nickel (Home).....	600	0	0
Platinum (Refined).....	23	5	0
Silver.....	6	3	
Gold.....	12	10	1½
Wolfram (U.K.).....	—	—	—
(World).....	3	5	0

Tin }  
 Copper } See Table, p. 108.  
 Lead }  
 Zinc }

# Energy Consumed by Rock-Drill Noise

Jan. Holdo <sup>1</sup>

The author presents

the results of a

recent study.

## Introduction

One of the problems facing industry, particularly in the use of rock-drilling equipment, has been the increase in noise generated by such machines. In the mining industry many different noise-producing machines are in use, including pneumatic drills, and this particular problem has been carefully studied in Sweden at considerable length with the object of reducing the noise factor without lowering either the efficiency or reliability of the machine.

One of the first points to arise was: What is the energy converted into noise in the machine and from which part of the machine is it produced? Some views on this question are presented in what follows, but, first, a few words must be said as to how noise intensity is measured.

Noise is generally measured and specified in *decibels* (abbreviated *dB*), a tenth of a *bel*, the decimal logarithm of the ratio of two acoustic powers, originally a convenient unit of power-level difference and used accordingly, not only in connexion with the noise phenomenon but is also in electronics. In the case of noise decibels are employed as a measurement of the acoustical energy which passes through a certain area. In physics flow of energy is usually specified in the

<sup>1</sup> Chief Engineer, Test Laboratory, Atlas Copco AB, Stockholm.

unit  $\mu\text{W}/\text{cm}^2$  (microWatts/cm.<sup>2</sup>). The *bel* connotes, in logarithm based on 10, how many times greater the flow of energy of a certain noise is in comparison with the flow of energy  $10^{-10} \mu\text{W}/\text{cm}^2$ —the so-called "threshold value"—which may be called *TV*—hardly audible to the human ear. A few examples will make this relation clear.

(1) How great a flow of energy implies a noise of an intensity of 90 *dB*?

$$90 \text{ dB} = 9 \text{ B} = 10^9 \times 10^{-10} = 10^{-1} \mu\text{W}/\text{cm}^2$$

Bel                      TV

(2) How great a flow is implied in a noise of 122 *dB*?

$$122 \text{ dB} = 12.2 \text{ B} = 10^{12.2} \times 10^{-10} \text{ TV} \\ = 10^{2.2} \text{ TV} = 158 \mu\text{W}/\text{cm}^2$$

Conversely it is of course possible to estimate the corresponding decibel value from a known acoustic flow of energy:—

(3) A sound, which on measurement has given a flow of energy of  $64.5 \mu\text{W}/\text{cm}^2$ , could be specified in *dB*, as follows:—

$$64.5 \mu\text{W}/\text{cm}^2 = 10^{1.81} \text{ TV} = 10^{-10} \times 10^{11.81} \text{ TV} \\ = 11.81 \text{ B} = 118.1 \text{ dB}$$

The connexion between *dB* and  $\mu\text{W}/\text{cm}^2$  is also apparent from the scale in Fig. 1, in which the above examples have been indicated by arrows. It is thus easy to estimate the noise flow of energy from its

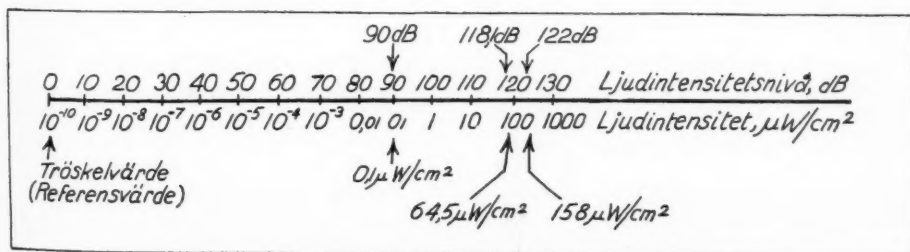


Fig 1.—Relation Between Decibels (dB) and Micro-Watts per cm.<sup>2</sup> ( $\mu\text{W cm}^2$ ).

decibel value to a corresponding energy flow value by means of a logarithmic table. This method is used in what follows to study the noise phenomenon in rock-drills. The decibel value is purely a physical measurement of the acoustic flow of energy and there are other units for specifying noise—*i.e.*, the *phon* and *sone*, for the determination of which consideration has been given to the varying sensitivity of the human ear dependent upon frequency and amplitude conditions in the noise. The present article, however, deals only with the pure energy problems in noises and these two latter units can therefore be disregarded.

### Noise Energy Produced by a Rock-Drill

In connexion with a drilling operation in a drive, using a standard rock-drill, Atlas Copco type BBD 45, a noise intensity of 119 dB was measured at a distance of 3.3 ft. (1 m.) away from the machine. The high intensity is to a large extent due to the noise being strongly amplified because of innumerable reflections from the hard rock walls, as shown in Fig. 2. Almost all noise energy must pass the area drawn in dotted lines in the figure, where the

operator and measuring instruments are placed. Owing to the rough walls the reflections are very irregular and the noise distribution obtained over the whole cross-section of the drive is very constant.

If the machine were freely suspended, as shown in Fig. 3, the noise energy produced passes outwards in all directions and the noise intensity, at a distance of 1 m., can then be assumed to decrease in an inverse proportion to the increased area over which the noise energy is spread.

If this area becomes 4 to 5 times greater the noise intensity will thus decrease 6 to 7 dB,—*i.e.*, from 119 to 112 dB.

This implies that through each square centimetre of the imagined surrounding sphere having a radius of 1 m. a flow of noise energy corresponding to 112 dB passes:—

$$112 \text{ dB} = 11.2 \text{ B} = 10^{-10} \text{ TVX } 10^{11.2} = 10^{1.2} \text{ TV} \\ = 15.8 \mu\text{W}/\text{cm}^2$$

Because the area of the sphere is:—

$$Y = 4\pi r^2 = 4\pi \times 10^4 = 12.56 \times 10^4 \text{ cm}^2$$

the total flow of energy transmitted is—

$$E = 12.56 \times 10^4 \times 15.8 = 199 \times 10^4 \mu\text{W} \\ = 1.99 \text{ W}$$

Consequently this constitutes the total noise

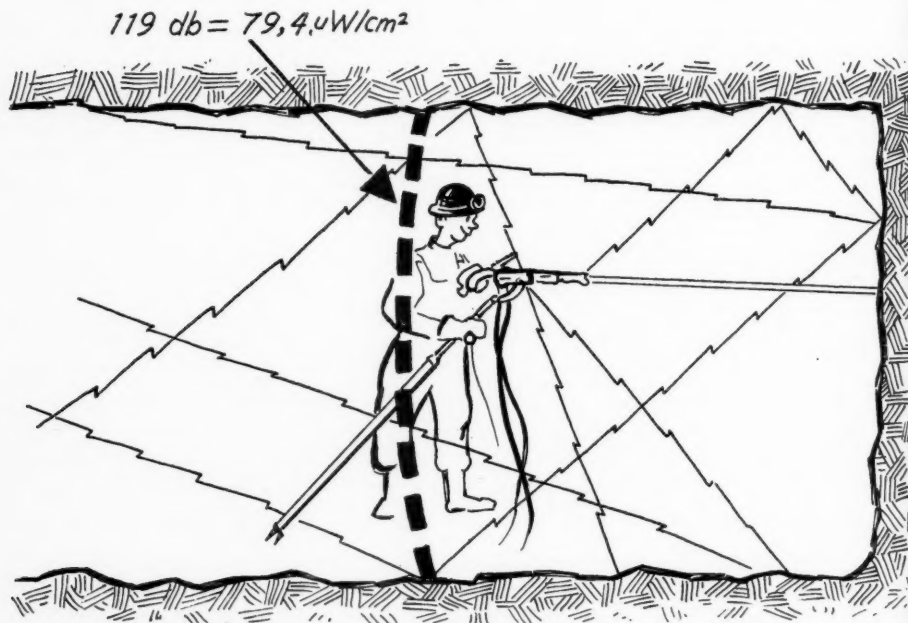
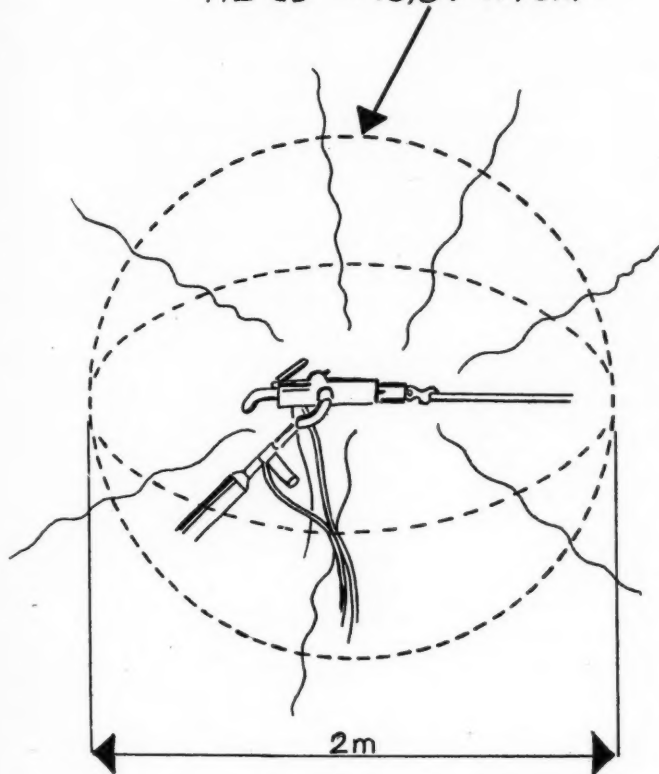


Fig. 2.—Noise Reflexes from Rock Walls: Almost all noise energy must pass the line indicated.

$$112 \text{ db} = 15,84 \text{ W/cm}^2$$



**Fig. 3.—Noise Intensity from a Drill Freely Suspended.**

produced by the rock-drill. If converted to conventional mechanical energy flow units the following is obtained :—

$$E = 0.203 \text{ kpm./s. (1.47 lb. ft./sec.)}$$

The rock-drill under test delivers to the drill steel a useful impact energy of about 16,000 kpm./min. (115,000 lb. ft./min.)—i.e., 267 kpm./s. (1930 lb. ft./sec.). In relation to the delivered useful effect the noise energy will thus only be 0.08%.

It is concluded therefore that only an exceptionally small part of the energy is converted into noise, but this nevertheless causes considerable discomfort because of the high sensitivity of the human ear.

#### Source of Noise

In general it can be said that the noise from a pneumatic rock-drill is produced from two different sources. One is the machine outlet, where the exhausted compressed air

produces noise because the air is at a relatively high pressure and escapes in pulses; this can be called the "exhaust noise." The second noise-producing source is the impact of the piston in the drill against the drill steel shank, which causes vibrations in the drill steel and in the different parts of the rock drill. This can be called "impact noise." If it is desired to study how much noise comes from one or the other source it is possible, when carrying out measuring, to attach a hose to the outlet of the rock-drill and thereby to conduct the exhaust air to a place where it does not cause disturbance. What then remains is the impact noise and the difference between the noise with and without the hose gives the intensity of the exhaust noise.

In Table 1 a few measured noise values when drilling in a drive with (A) a standard rock-drill in normal operation and (C) with a

long hose for the exhaust air are given. In the table a value for the rock drill fitted with a special cylinder silencer, being developed, has also been included. This cylinder is provided with specially-designed outlet openings whereby the exhaust noise generated is reduced. On the other hand, it does not affect the impact noise. In the table the measured *dB* values have also been given in corresponding  $\mu\text{W}/\text{cm}^2$ .

Table 1

	Noise Value
(A) Standard machine	119 <i>dB</i> = 80 $\mu\text{W}/\text{cm}^2$
(B) Same machine fitted with cylinder silencer	113 <i>dB</i> = 20 $\mu\text{W}/\text{cm}^2$
(C) Same machine with the ejected air conducted away in a long hose	110 <i>dB</i> = 10 $\mu\text{W}/\text{cm}^2$

### Conclusions

The following conclusions can be drawn from the table:—

- (1) The *impact noise* is  
110 *dB* = 10  $\mu\text{W}/\text{cm}^2$
- (2) The *exhaust noise* for the standard machine increases the noise with the difference between A and C—*i.e.*,  
119 — 110 = 9 *dB* = 0.9 B = 8 times =  $\frac{80}{10}$   
or also 80 — 10 = 70  $\mu\text{W}/\text{cm}^2$
- (3) Of the *total noise* from the rock-drill the following percentages are derived from:—  
The impacts, 12.5%  
the outlet 87.5%

(4) If only the exhaust noise existed the total noise value would thus be 70  $\mu\text{W}/\text{cm}^2$ , corresponding to 118.4 *dB*

This shows, first, that it is important to reduce the exhaust noise, as it certainly produces most of the noise. It is also apparent how easy it would be, without understanding the meaning of *dB* values to draw the wrong conclusion—*i.e.*, that most of the noise is produced by the impacts between the piston and the drill steel.

As regards the silencer the following can be derived from the values given in the table:—

(5) The silencer reduces the noise from 119 *dB* to 113 *dB*—that is, specified in  $\mu\text{W}/\text{cm}^2$ , the noise with silencer is reduced by 60  $\mu\text{W}/\text{cm}^2$ . In other words, the silencer removes about 75% of the total noise energy which would otherwise be produced by the standard type of rock-drill.

(6) If consideration is given only to the exhaust noise the silencer reduces it from 70  $\mu\text{W}/\text{cm}^2$  to 10  $\mu\text{W}/\text{cm}^2$ —*i.e.*, to one-seventh of the original value. Specified in *dB* the reduction is 118.4 — 110 *dB* = 8.4 *dB* = 7 times. Of the noise energy produced by the outlet the silencer thus removes about 85%.

(7) With a silencer fitted to the machine the noise produced by the impacts and the ejected air has the same intensity—10  $\mu\text{W}/\text{cm}^2$  = 110 *dB* each, which, added together, makes 20  $\mu\text{W}/\text{cm}^2$ .

## Conference in Freiberg

H. L. Holloway, A.M.I.M.M.

In the period from May 28 to May 31 last the tenth conference at the Freiberg Mining Academy to be held since the Second World War was successfully concluded. The conference, or "tagung", to give it its German title, was attended by some 1,300 engineers and scientists, of whom approximately 1,000 were from the Soviet Zone of Germany, 150 from Western Germany and

Berlin, and the remainder chiefly from the Eastern Block of European countries, including Russia, but with several from China, France, Belgium, Yugoslavia, Norway, and Austria and with one each from Finland, Japan, and England. The visiting delegates were housed in the quarters of the Academy students, vacated for the occasion, and meals were served at a low charge in restaurants

A brief account

of a mining

occasion in Eastern

Germany.

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**Engineering  
Building,  
Freiberg.**

managed by the H.O.—the State trading enterprise. The catering was adequate, if not sumptuous. Every effort was made by the "tagung" organizers and by the State officials to make the stay as pleasant as possible for the visitors and there was full liberty of movement.

Freiberg Academy has, of course, a history with roots reaching far into the past. Previous to its foundation in 1766, the town had for centuries held a tradition of instruction in mining and the sciences connected with mining. Ulrich Rülein von Calw wrote there what must surely be one of the first, if not the first, mining textbook—"Ein Nützlich Bergbüchlein" (A useful Little Book on Ores)—in the year 1500, 56 years before the appearance of "de Re Metallica".<sup>1</sup>

<sup>1</sup>This will recall to readers the publication in 1949 by the American Institute of Mining and Metallurgical Engineers of a translation of the "Bergwerk- und Probierbüchlein," two other early German mining texts; See THE MINING MAGAZINE, Sept., 1949.

The foundation of the Academy was finally approved by Prince Xaver, Regent for the young Elector of Saxony, in December, 1765, and it was opened at Whitsun in the following year. The subjects taught were pure mathematics, mechanics, aerometry, hydrostatics, hydraulics, draftmanship (survey, geological and machine plans), mineralogy (in connexion with the mineralogical collection), mining practice, assay practice, design of surveying and assaying instruments and tools, and the preparation of models. Many internationally-famous names are linked with the Academy, either as instructors or as pupils—amongst others, Christian Fürchtegott Gellert, Abraham Gottlob Werner, Alexander von Humboldt, Wilhelm August Lampadius, and Clemens Alexander Winkler.

The Conference was opened on the morning of May 28 by a procession of the Professors into a large hall, where the visitors were seated, to the accompaniment of the Egmont overture from Beethoven, beautifully rendered.



**Open-Cast  
Mining  
Institute.**

A speech of welcome was then given by the Rector of the Academy (Prof. Dr.-Ing. Härtig), followed by a speech by the Mayor of Freiberg and by a series of short speeches by heads of delegations from various countries. To close the ceremony, Herr Rudolf Steinwand, Minister in the D.D.R. Government, gave a rather long speech, almost entirely political. From the afternoon of May 28 to the evening of May 31, inclusive, some 130 papers were presented, many of them of great interest, dealing with all aspects of mining and metallurgy, physics, geology, mechanical and electrical engineering, surveying, coal beneficiation, mineralogy, geophysics, steel rolling, and with the International Geophysical Year and rocket technique. It was physically impossible to hear more than a selected number of the papers, as they were presented and discussed in Academy buildings dealing with the appropriate branch of study and these buildings cover a large area. On the morning of May 29 selected representatives of the visiting engineers were invited to the opening of a new Geological Institute, while, in the evening of the same day, those attending the Conference were invited to an afternoon meal attended by Herr Otto

Grotewohl, Minister President of the D.D.R. Herr Grotewohl spoke at some length on the advantages of life in the Eastern, as compared to the Western, Zone of Germany. There were various other social functions and concerts, etc., at all of which the utmost cordiality was shown to the visitors. After the close of the Conference visits were arranged to Dresden and its surroundings. The central portion of Dresden still lies in heaps of rubble, although a few buildings have been rebuilt, among them the Opera House and the Picture Gallery.

Impressions left by the Conference (leaving those of a political or economic nature, which are outside the scope of this report) are the earnestness with which dissemination of new ideas on technical and scientific subjects is held, the drive for higher education amongst the younger generation, and, arising from this, the activity in erecting new and adequate buildings for the housing and instruction of students. Since the last war the number of students at the Academy has increased no less than fifteen-fold, not including correspondence students, and building activity has kept pace to cope with this increase. Lastly the desire shown for cultural relations with the Western countries should be mentioned.

## Solvent Extraction of Uranium

Pilot studies  
carried out in  
the United States  
are briefly described

### Introduction

At the Chicago meeting of the American Institute of Chemical Engineers earlier this year a symposium on extraction metallurgy created wide interest. In one of the papers presented K. Black and J. Koslov gave details of studies carried out by the Vitro Corporation which show the progress that solvent extraction or liquid ion-exchange has made as a metallurgical process for the recovery of uranium. Mills using solvent extraction can, it appears, process pregnant liquors having higher feed compositions than originally anticipated with few operational changes.

In addition, solvent poisons can be kept at a tolerable level by continuous conditioning of a side stream of solvents and performance problems specific to particular feed stocks can be overcome by modifying process conditions or modifying the solvent. The illustrations used for this article were supplied by the Vitro Corporation.

### Plant Results

In 1955 a pilot plant was installed by the Vitro Uranium Company in Salt Lake City to determine whether solvent extraction of uranium could be used on liquors or slurries

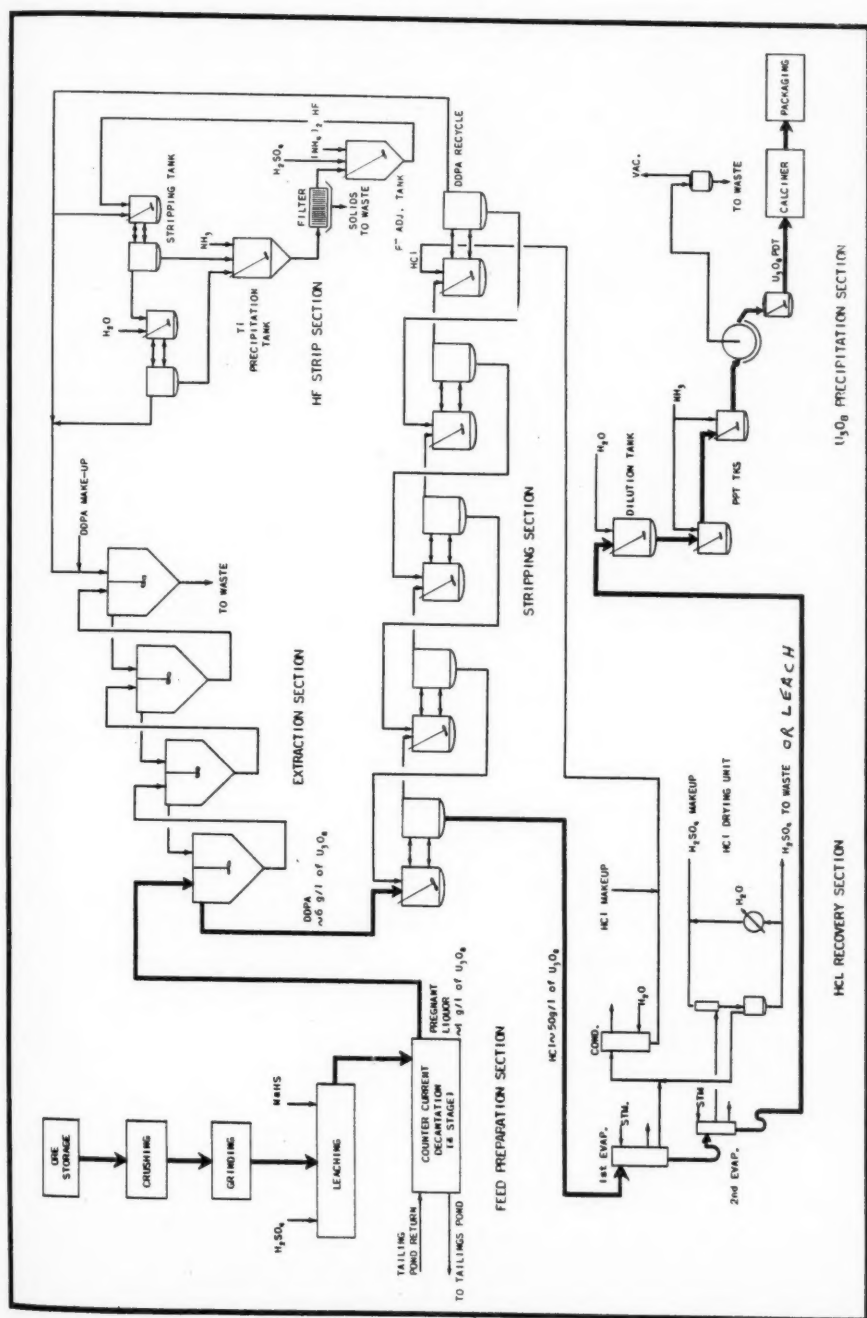
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**Fig. 1.—Diagrammatic Flow-Sheet.**

obtained from their ores. This programme indicated that solvent extraction techniques could be used and in 1956 the design of a 660 ton per day mill was begun by Vitro Engineering; this was expected to start production in the summer of 1957. Fig. 1 gives a simplified flow diagram for the plant.

Various ores are handled by Vitro Uranium, including uraninite, autunite, and carnotite minerals in sandstone sediments together with various alteration products. Ore crushed to 1 in. is received at the mill and dumped into 100-ton track hoppers or stockpiled along various railway spurs. The first concern is to blend the various ores to produce a uniform plant feed of 0.25% to 0.30%  $U_3O_8$  which is amenable to the process conditions used.

All ore enters the mill circuit through the track hopper, from which it is conveyed to the crushing plant. Here its mesh is reduced to  $\frac{1}{2}$  in. and it is stored in silos to permit further blending. Ore from the silo is conveyed to the grinding circuit, where it is wet ground to a satisfactory size. The ore slurry then goes to the leaching circuit where the uranium is treated with sulphuric acid. Oxidizing agents are also used to increase uranium solubility and to oxidize the uranium to the hexavalent state, forming uranyl sulphate. Reduction of the ferric iron is carried out in the last leach vessel by the addition of sodium sulphide. The leached residues are then separated from the uranium-bearing pregnant liquor in a four-stage counter-current decantation system.

Pregnant liquor overflow from the first stage, containing about 1 g.  $U_3O_8$  per litre, is pumped to the extraction section of the solvent extraction plant. Here it is contacted by a solvent (dodecyl phosphoric acid) which extracts the uranium from the aqueous phase; the raffinate is pumped to waste. Uranium-rich organic goes to the stripping section where uranium is stripped from the solvent by 10 N hydrochloric acid. The stripped solvent is recycled to the extraction section and the uranyl chloride-hydrochloric acid solution is pumped to the HCl recovery unit.

A two-stage evaporation unit is used for acid recovery. The uranyl chloride solution is concentrated about tenfold; vapours are treated with concentrated sulphuric acid to control their composition to 31.6 wt. % HCl (10N), vapours then being condensed and recycled to the stripping section.

Concentrated uranyl chloride is diluted with water and the uranium values precipitated from the solution by anhydrous ammonia. Ammonium diuranate is filtered from the liquor and pumped to a calciner which converts the ammonium diuranate to  $U_3O_8$  and reduces the chloride contamination to tolerable levels.

Provision has been incorporated into the solvent extraction process for treating the recycled solvent with hydrofluoric acid to regenerate it completely by stripping it of solvent poisons which are not removed by hydrochloric acid.

### Solvent Characteristics

Dodecyl phosphoric acid was selected by Vitro for its solvent extraction process for the following reasons: Low first cost for solvent; low solubility of solvent in the aqueous phase; high uranium concentration ratios; low overall chemical costs, and laboratory data which show promise of adaptability of solvent to processing slurries. Dodecyl phosphoric acid can easily be prepared from the commercially-available dodecyl alcohol, 2, 6, 8 trimethyl nonanol.

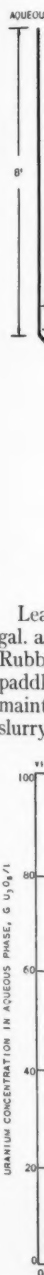
### Crushing and Leaching

Crushed ore from storage is conveyed by a 30-in. belt-conveyor into the crushing plant. The 1-in. ore is crushed to  $\frac{1}{2}$  in. in a 30 by 30 impact breaker operating in a closed circuit with screens. Screened ore is stored in silos for further blending.

The ores are first segregated by acid requirements for leaching and one group, classed as "more amenable," is further divided according to lime ( $CaCO_3$ ) content. From storage the ores are fed to the two grinding circuits. If asphaltic ores are being processed the crushed ore is sent to roasters before going to the grinding circuit.

Ore which has been classified as "difficulty amenable" is conveyed from storage to the first grinding circuit. Here the ore is discharged to a 6 ft. by 4  $\frac{1}{2}$  ft. ball-mill operating in closed circuit with an Akins spiral classifier. The ore is wet ground at 60% solids to minus 28 mesh.

"More amenable" ores are conveyed to a second grinding circuit where their size is reduced to minus 20 mesh. Here again grinding is carried out at 60% solids, using an Eimco 6 ft. by 5 ft. ball-mill in closed circuit with a Dorr-type Duplex rake classifier.



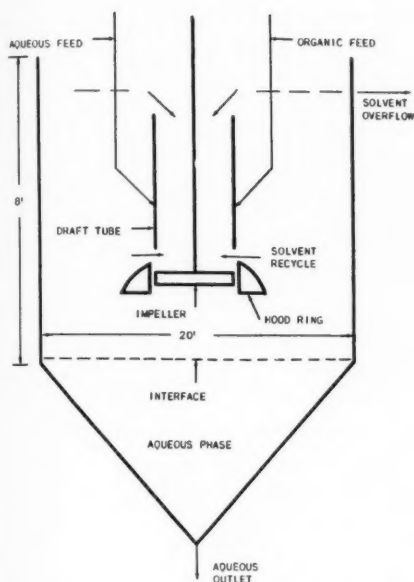


Fig. 2.

Leaching is carried out in a series of 13,000-gal. acid-resistant tanks functioning in series. Rubber-covered, cast-steel turbine blade paddles are used to provide agitation to maintain the ore particles in suspension. The slurry enters the tank at the bottom and

discharges to the next tank by gravity overflow.

The more "difficulty amenable" ores are fed to the first leach vessel and are joined with more amenable ores at a point further along in the leach process. Sulphuric acid and an oxidizing agent are fed to the first tank and at the entrance of the second ore stream. The ferric iron is reduced and some heavy metals are precipitated in the last leach tank. Reduction is effected by sodium sulphhydrate with control determined by ferric iron concentration.

Leached residues and heavy-metal sulphides are separated from the uranium-bearing pregnant liquor in four 70 ft. diameter washing thickeners, having 316 stainless-steel rakes. The underflow solids are pumped by diaphragm pumps, with the final underflow going to the tailings pond. Dow Separan 2610 is added as a flocculant in each stage. The stage one overflow, containing about 1 g.  $U_3O_8$  per litre is pumped to the solvent extraction process.

### Solvent Extraction

Four-stage counter-current extraction is used to recover uranium from the pregnant liquor. Thickener overflow is pumped to the first extraction stage; the raffinate from the fourth stage is pumped to the tailings pond. Solvent enters the extraction section at the fourth and highest stage to the stripping

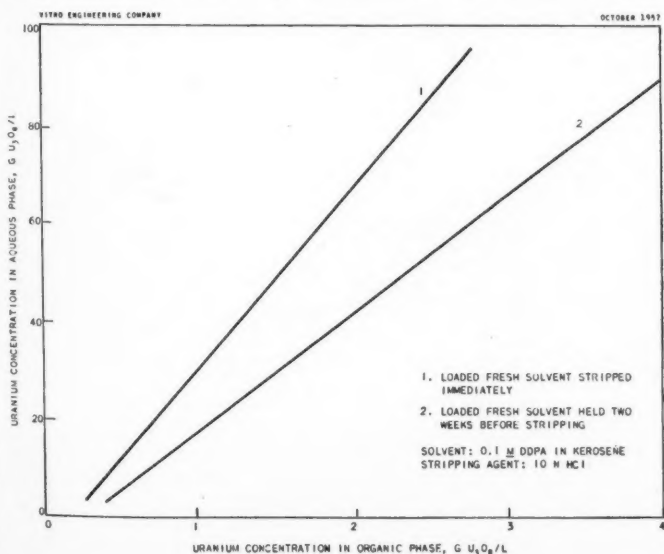


Fig. 3.

section. Aqueous underflow is pumped from one stage to the next.

Each extraction stage (Fig. 2) is carried out in a tank measuring 20 ft. in diameter and having a cone bottom with a gas dispersion type agitator to provide the necessary phase contact. Aqueous and solvent feed stream inlets are located in a tube relatively near the impeller. An annular opening between the hood ring and the tube provides recycle of the solvent phase. Additional solvent is recycled through the top of the tube. The extractor is operated with the organic phase continuous at internal O/A ratios in excess of 1.5 to 1. This internal O/A ratio can be controlled by raising or lowering the aqueous interface or increasing or decreasing the turbine speed.

The operation of the extraction section can be controlled in several ways. Aqueous flow and organic flow can each be varied at a given flow; the organic flow can be altered at a given ratio to the aqueous flow, or flow of

lean organic stream can be controlled by properties—*e.g.* specific gravity—of the rich organic stream. There is an interface controller in each tank to prevent interstage by-passing and solvent losses. All equipment has corrosion-resistant linings.

The limiting design parameter for the extractor is the aqueous settling rate. Vitro pilot-plant data confirm the upper capacity limit for good extraction determined by Dow (3).<sup>1</sup> Operation above this limit increases solvent by-passing and losses.

The extraction section was designed to operate at external O/A ratios between 1/8 and 1/6 to discharge raffinate containing less than 0.002 g.  $U_3O_8$  per litre using solvent stripped to 0.2 g.  $U_3O_8$  per litre.

### Solvent Stripping

Uranium-rich solvent is stripped with concentrated (10 N) HCl in a five-stage counter-

<sup>1</sup> References are given at the end of the article.

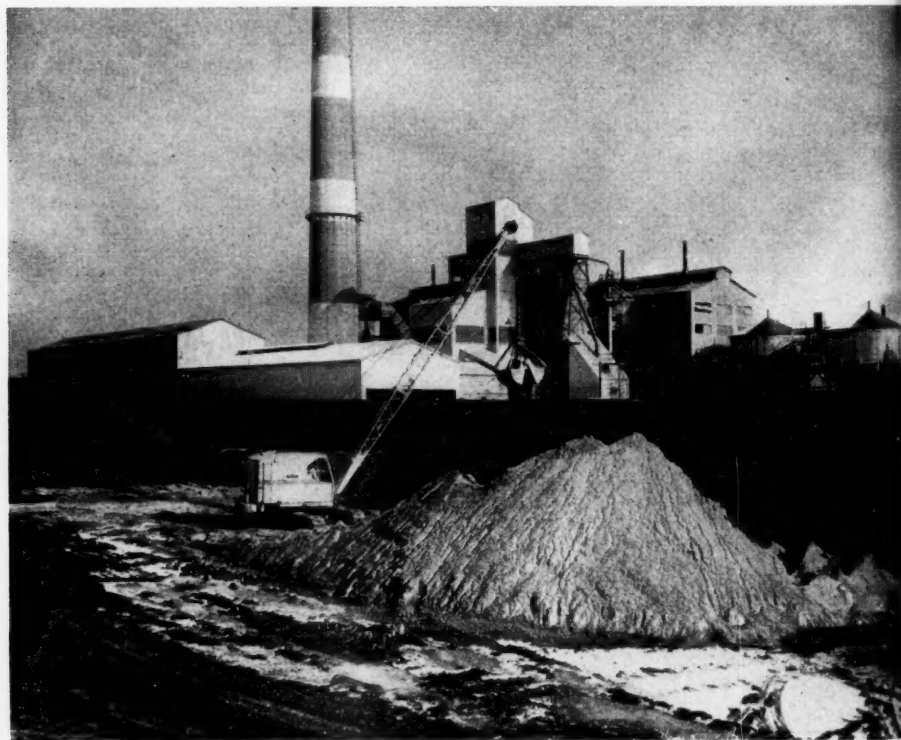


Fig. 4.—Stock-Piled Ore at Salt Lake City.

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Fig. 5.—Mining Uranium Ore in Wyoming.

current stripping section. Each stage consists of two tanks (10 ft. diameter) with two parallel interconnexions. One vessel is agitated; the other acts as the settling chamber. The organic overflows from one stage to the next, while hydrochloric acid is pumped from one stage to the next. Stripped organic is recycled to the extraction section and uranium-rich HCl goes to the HCl recovery unit. Hydrochloric acid feed to the stripping section is controlled by a flow controller at a predetermined ratio to the organic flow. Interface controllers are used in each settler.

The design of the stripping section was based on the need to strip solvent to 0.2 g.  $U_3O_8$  per litre. The size and number of stages represents a balance between increasing number of stages and decreasing mixer volume. Minimum residence times in excess of 30 min. have been provided.

Violent agitation is used in the strip mixers. Although gas-dispersion agitators could have been used and the mixing-settling effected in a single vessel, internal recirculation of organic would have necessitated larger vessels to give the required residence time.

The stripping section was designed to operate at O/A ratios of 8/1 to 12/1 and

reduce the uranium content of the organic to 0.2 g.  $U_3O_8$  per litre. A minimum hold-up is used between the extraction and stripping sections to prevent "ageing" of the solvent. When the solvent laden with uranium stripping for any appreciable period uranium stripping becomes much more difficult (Fig. 3).

#### HCl Recovery

Uranium-rich HCl containing between 50 g. and 100 g.  $U_3O_8$  per litre is evaporated to recover as much hydrochloric acid as possible. The recovery unit consists of a two-stage, vertical, falling-film evaporator, a dehydrating unit, and a condenser. The uranyl chloride-HCl stream is fed to the top of the first stage evaporator. Evaporator bottoms containing about 300 g.  $U_3O_8$  per litre flow by gravity to the second evaporator, the bottoms from this unit containing about 800 g.  $U_3O_8$  per litre. Vapours from the second evaporator are dried with concentrated sulphuric acid, using an evacuator to provide the phase contact. After the sulphuric acid has coalesced it is recycled to the evacuator through a cooler. Concentrated sulphuric acid is added as required to maintain a sulphuric acid concentration of 75% and a bleed stream of sulphuric acid is sent to the leach circuit.

**Table 1**  
**Solvent Extraction Plant Costs**

	% (of direct plant cost)
Building . . . . .	28.4
Tank Farm . . . . .	7.5
Extraction . . . . .	19.9
Stripping . . . . .	22.8
HCl Recovery Unit . . . . .	6.9
Precipitation and Filtration . . . . .	7.2
Solvent Treatment . . . . .	5.9
Miscellaneous . . . . .	1.4
(Alternative Breakdown)	
Structural . . . . .	27.0
Equipment . . . . .	35.6
Piping . . . . .	13.2
Instrumentation . . . . .	16.0
Electrical . . . . .	8.2

Hydrogen chloride from the dehydrating unit is mixed with the vapours from the first-stage evaporator and the mixture is condensed. The recovery unit is operated to recover IO N acid (31.6 wt. %).

#### Precipitation Section

Concentrated uranyl chloride solution from the second evaporator is diluted with water and pumped to the precipitation section. The uranium values are precipitated as ammonium diuranate in a bank of agitated vessels. Slurry from the last tank overflows to a vacuum rotary filter. The ammonium diuranate solids are discharged to an agitated tank and pumped to a calciner, where the  $(\text{NH}_4)_2\text{U}_2\text{O}_7$  is converted to  $\text{U}_3\text{O}_8$  and the chloride concentration is reduced to a satisfactory level.

#### Solvent Treatment

In order to maintain the effectiveness of the recycled solvent for uranium recovery a periodic or continuous hydrofluoric acid treatment step is used to strip titanium from the solvent. Mixer-settlers similar to those in the HCl stripping section are used for the HF section. The solvent is stripped with an acidified ammonium fluoride solution, washed with water, and recycled to the extraction section. The titanium is precipitated from the ammonium fluoride solution by ammonia. Solids are removed by filtration and the filtrate is acidified with sulphuric acid and its fluoride concentration adjusted with ammonium bifluoride ( $\text{NH}_4\text{HF}_2$ ). The solution is then recycled to the mixer-settler unit.

A small solvent make-up system has been included in the solvent extraction plant. The system consists of two major vessels—a reaction tank and a dilution tank. Since losses are expected to be low solvent make-up was designed for infrequent batch operation.

#### Bibliography

- (1) MOORE, J. D. "Uranium Recovery by the Solvent Extraction Process." *J. Metals*, **9**, 757-761 (1957).
- (2) ELLIS, D. A. "Recovery of Uranium from Colorado Plateau Ores by Solvent Extraction." DOW-131, July, 1955 (unclassified).
- (3) VALLE-RIESTRA, J. F. "Carnotite Solvent Extraction Process: Process Description." DOW-123, November, 1954 (declassified).

#### Uranium Plant for Sweden

Plans for a new uranium extraction plant using native schist deposits from Mt. Billingen, in south-west Sweden, have now reached the blueprint stage, it is announced by AB Atomenergi. The new plant—to be called the Ranstad Works—is to produce 120 tons of uranium per annum, which presupposes the mining of 900,000 tons of crude schist. It is to include crushing and sorting works, a lixiviation plant, refinery, office and service buildings. The total cost of the works is estimated at Kr. 115,000,000 (£7,930,000) with an additional cost for the refinery of Kr. 10,000,000.

The carbonaceous "schist" to be worked contains calcareous material, which is to be separated from the schist during the production process and be used for neutralizing the waste solutions from the lixiviation plant. The refined ore contains about 320 g. uranium per ton. The shale portion of the schist retains its structure and its fuel value through the lixiviation process, the "waste" product having a fuel value corresponding to that of 500 tons of coal per day. It will thus be possible to burn the shale and generate steam and electric power and to extract sulphurous products, especially sulphuric acid—used in the leach process. Arrangements for such purposes are not at present included in the actual plans but may be added to the works later.

The Ranstad Works are expected to be completed in the course of 1962, preparatory work being due to start this autumn. When completed the works will have a staff of some 330 employees, of whom 60 to 70 will be administrative personnel.

## Ore-Dressing Notes

### (4) Gold

#### Improvements at Van Dyk Consolidated

A paper by A. H. Mokken in the February *Journal of the South African Institute of Mining and Metallurgy*<sup>1</sup> gives a valuable record of the technical and economic improvements made in a Rand cyanide plant as the result of detailed study, improved control, and labour saving. Cleaning of filter cloths was improved and speeded up when the work of 12 labourers was taken over by an electrically-driven mobile brush. Filter operation was further improved when the pulp level of the feed was automatically stabilized. This was achieved by the use of compressed air relayed to the valve controlling feed entry in accordance with the movement of a cistern-type ball valve floating in the filter tank. Residues repulped after filtration gave trouble in the original two-stage pumping system. Most of the trouble came from shock when the suction was not fully submerged. It was cured by resiting and the use of a surge tank which operated on the variable speed of the redesigned pump line. With the reduction of pumps, labour, and supervision which resulted costs dropped from 0.48d. per ton milled to 0.18, a substantial saving.

Some interesting improvements to the steadiness of the grinding circuit were made possible by attention to the mill water supply. A badly-scaled pipe may look all right but when an increased demand arises it may upset the balance between the various take-offs which it serves. Scale removal was a slow business until the extended use of "go-devils" was made possible. Pipes were re-routed so that the mill supply was drawn from the rising main (toward the steady head) and tappings were made at appropriate points into and from which the go-devil could be moved. One obdurate obstruction was located by means of a radioactive isotope which showed where the go-devil carrying it had lodged. A 6-ft. pole was thus found and removed. As the diluting water for a given valve setting depends on the hydraulic pressure at that point (pipes being properly clean, of course) thought was given to control based on pressure indicators as the quick

method of handling fluctuations. Simple gauges were devised and operation correspondingly simplified. Other detailed improvements are described in this connexion by the author. These include watch over the turbidity in the mill water, which is said to affect grinding and gold extraction particularly in the cold season.

On cyanidation the conclusions recorded by Kudryk and Kellogg<sup>1</sup> (regarding the control of solution rate by rate of diffusion of oxygen or cyanide) have been followed up. Since the final concentration of cyanide (stated as KCN) at Van Dyk is 0.02%, as against the 0.0175% below which cyanide diffusion controls attack of gold, attention was given to improved aeration. This, with the mechanical agitators in use, has an optimum value of 16 c.f.m. of free air per 1,000 cu. ft. of pulp. Losses due to incomplete removal of dissolved gold during filtration has led to modifications in the design and operation of the rotary filters and brought the original 0.04 dwt. per ton of cake down to the current 0.01. Steps in this improvement included a change from horizontal to diagonal grids, which reduced the volume of pregnant filtrate in the channels and therefore the risk of blow-off loss. Use of a thick scraper allows the cake to build up on its edge and deflect blow-off solution back to the filter trough. Automatic sampling of residues, the use of non-scaling asbestos-cement piping for sprays, and improved control of vacuum are among the measures used. This last item is worked by an electrode in the wet vacuum receiver which signals a rise of solution to the height where it might rise above the incoming filtrate pipe and thus cut off the vacuum in the drum. Dissolved gold loss is mainly controlled by filter duty and filter wash and the hunting down of the causes of variable solution level in the wet vacuum receiver (the main determinant of efficient vacuum and hence of solution removal) followed. These included the condition of the filtrate pumps, the pumping head, and the duty. Minor factors were valve troubles, wrong blow-off settings, and bad distribution of wash liquor.

An important addition to the systematic mechanical descaling of pipes in connexion with steady setting of solid/liquid ratios etc. has been the use of "inhibited" acid to attack lime scale. Precipitation of calcium

<sup>1</sup> See THE MINING MAGAZINE, Apr., 1958, p. 248.

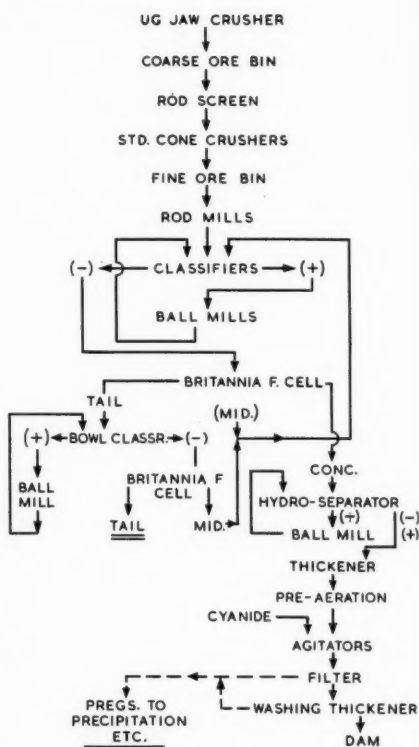
<sup>1</sup> Trans. A.I.M.E. 541 (May, 1954).

carbonate begins on the filters and continues right through the de-aerated travel of solution until absorption recommences in the "barren" storage tank. This scale clogs filter cloths, grids, pipelines, clarifiers, the Crowe tank, and the Merrill precipitating units, and its formation is accompanied by lowered efficiency. In 1950 acid inhibition was tried on the filters and was so successful that its use has been extended in the cyanide plant. Acid inhibitors are long-chain complex organic compounds usually of high molecular weight. They were developed to reduce corrosion and hydrogen embrittlement in such work as pickling metals before galvanizing and other metallurgical treatments, where they have taken the place of starch, bran, glue, etc. They form a film at the metal surface which retards diffusion and action between metal and the acid containing the inhibitor while leaving lime scale open to attack. Instead of the usual acid wash sprayed on to the filter drum with its attendant corrosion hazards the inhibited acid is pumped through the filtrate pipes into the grid grooves. Now the drums are clear, a 1% solution suffices to keep them free, though a once-monthly spray must still be used on the filter cloths. The Merrill pits have now been treated for five years, saving time and labour and aiding removal of auriferous slime without chipping. A 1% solution is used for four hours and 1% to 1½% acid is used for the leaf clarifiers. The tube-mill trunnions which are water-cooled are also treated.

### (5) Gold

#### Britannia's Snow Lake Mill

This mill in northern Manitoba treats a gold and silver ore carrying arsenopyrite, pyrrhotite, and pyrite occurring in altered acid and basic volcanic rocks. Operations began in 1949 with rougher-cleaner flotation followed by cyanidation of the arsenical concentrate. Several modifications have led to the current practice, which gives a recovery of over 80% on a 1,700 ton per day feed. Two rod-mills in open circuit reduce the 96% minus 1½ in. feed to 14 mesh. The products are divided between three ball-mills (Fig. 1) in closed circuit, followed by first-stage flotation. The flotation middlings are



2,000 ton/day Flow-Sheet.

returned to the closed circuit, the tailings reground in a ball-mill closed by a bowl classifier, and the concentrates receive further closed-circuit grinding.

The overflow from the tailings regrind goes to second-stage flotation, whence a final tailing is discarded, while the float joins the first-stage flotation middling in the primary ball-mill circuit. Each flotation is performed in a Britannia cell, 65 ft. long by 5 ft. by 10 ft. The concentrate finally leaving the regrind section (closed by a hydroseparator) is thickened, pre-aerated, and then cyanided in a series of three agitators. The pulp is then filtered, rewashed, thickened, and discarded.<sup>1</sup>

<sup>1</sup> Abstracted from a description by B. G. Macdermid, 6th Commonwealth Congress "The Milling of Canadian Ores," p. 121.

(6) *Comminution***Size of Grinding Media**

In a recent paper<sup>1</sup> F. C. Bond reevaluates the formula given by him in the Mineral Dressing Symposium (I.M.M. London, 1953) for the size of make-up balls. This was—

$$B = \sqrt{\frac{FWi}{KCs}} \sqrt{S/\sqrt{D}}$$

where B = ball, rod, or pebble diam. in in.  
 F = size in microns 80% of new feed passes.  
 Wi = work index at the feed size F.  
 Cs = percentage of mill critical speed.  
 S = specific gravity of material being ground.  
 D = mill diameter in ft. inside liners.  
 K = 200 for balls; 300 for rods; 100 for silica pebbles.

This equation was based on several concepts, some of which have been amended after further analysis. The first of these, that the largest ball in the crop load should be able to break the largest normally occurring feed particle stands. The author assumes that a 1 in. diam. steel ball is effective on feed 80% of which passes 16 mesh. The breaking force varies with the weight, or cube of ball diameter, while the resistance to shatter of the particle varies as its cross-section or diameter squared. Hence, if a 1-in. ball breaks a 1-mm. particle (16 mesh) a 2-in. ball deals with 4-mm. feed, 3 in. with 9 mm., and so on.

The relation between ball size and work index is shown in the equation above as  $B \propto \sqrt{Wi}$ , but since the work is equal to force multiplied by distance, and the latter is not tied to Wi, the breaking force required is a function of ball weight and  $B \propto \sqrt[3]{Wi}$ .

Further discussion in this valuable paper deals with amended valuation of the relation between ball size and particle density ( $B \propto \sqrt[3]{S}$ ) as against the original ( $B \propto S^{\frac{1}{4}}$ ). Again, ball size is related to critical speed by

the factor  $(B \propto \sqrt[3]{\frac{1}{Cs}})$  and not  $(B \propto \sqrt{\frac{1}{C}})$ .

The diametric relation between mill and ball is also amended. The new equation reads:—

$$B = \left(\frac{F}{K}\right)^{\frac{1}{3}} \left(\frac{S Wi}{Cs \sqrt{D}}\right)^{\frac{1}{3}}$$

the values of the proportionality constant K being given in a table for a variety of media and circuits.

<sup>1</sup> "Grinding Ball Size Selection," *Trans. A.I.M.E.*, May, 1958.

The calculation made, the nearest commercial ball size is chosen for topping up the mill charge. Somewhat larger balls may be preferred for cheapness, for improved power draft when small balls are used in a large-diameter mill, and to minimize blinding of grate openings. The writer of this note would also bring into consideration the ratio of new ball weight to discard size weight in a case where the crop load was being regularly checked over.

The paper referred to here includes tables on weight, volume, and surface area of balls and rods; start-up equilibrium charges; replacement rate in terms of power and tonnage, and advice on composition of the original charge.

## Book Reviews

### Commonwealth Geology

#### (1) **British Borneo** : Reports, 1957.

Earlier this year it was a pleasure to review the 1956 Annual Report; now a similar volume is available for 1957, to which the same remarks apply. The frontispiece shows that great progress has been made in the amount of the country that has now been covered by surveys. The scales used in some of these surveys are admittedly small, but there are many who would hold that to cover as much of the country in this way as quickly as possible is full justification for the scale.

The reviewer considers the Survey is again to be congratulated and thinks there are many who would like to see some of the non-publishing Surveys following similar lines.

During the period concerned Memoirs 5, 7, and 8 have also appeared and these cover very substantial parts of the Territory.

#### (2) **Hartley Gold Belt, Southern Rhodesia** :

Southern Rhodesia Geological Survey Bulletin No. 44. By J. W. WILES. Part I—Geology, limp cloth, 111 pages, illustrated, with map. Part II—Gold Deposits and Mines, limp cloth, 188 pages, with maps. Salisbury : Government Printers.

Bulletin No. 44 of the Southern Rhodesian Survey has now been published in two parts to cover new work on the Hartley area. The first part deals with the general geology and the second part with the gold deposits and mines. Valuable revision of the maps is included, as well as much new information.

(3) **Bechuanaland Protectorate :** Coal Exploration—Records of Bore-holes.

A most interesting compilation has been issued by the Bechuanaland Government. No one doubts the value of the work done by the Geological Surveys of the Empire, but so often this becomes pigeon-holed and available only to those who make the special effort to find out what a particular Survey has been doing. This volume might be considered to go to the other extreme; in 267 pages the very fullest account is given of all the drilling for coal carried out by the Geological Survey Department since 1950. Diagrammatic logs are also provided.

Whether or not this succeeds in attracting the attention of the right people towards the work that has been done, the publication must at least show how thorough the efforts of the Department have been. The volume is issued at 3s., a fraction of the cost of the paper alone.

R. A. MACKAY.

**Flotation Fundamentals.** Stiff paper, 107 pages, loose leaf. Midland, Michigan, U.S.A. : The Dow Chemical Company.

This little textbook—it cannot in truth be regarded as a catalogue—is put out by the Dow Chemical Company of America. It contains eight chapters and is beautifully prepared and illustrated. Chapter I, largely historical, covers the scope of the flotation process, outlines its mechanism, and offers some definitions. Then comes an account of flotation reagents—collectors, frothers, and modifiers—and a list of Dow flotation agents and chemicals. There follow a review of the applications of flotation, an essay on ore testing, and a series of formulae and tables for milling calculations. Chapters VII and VIII deal with the interpretation of data, tabulate the properties of metallic and non-metallic minerals, and give some handy reference conversion factors.

**Chambers Technical Dictionary :** Revised edition, 1958, with supplement. Cloth, octavo, 1,028 pages. Price 35s. Edinburgh : W. and R. Chambers.

This standard work of reference, hailed widely as a fine piece of work when it first appeared in 1940, has already gone through seven revisions and two reprintings, evidence enough of its usefulness. The new revised

edition now available goes far to cover recent advances in all branches of science, both pure and applied and it will no doubt continue to serve all interested in technological progress.

Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

## Engineering Log

The large-scale winning of peat has been made possible by mechanization. In an article describing its winning and use Anthony Parker<sup>1</sup> defines peat as the product of decay of vegetable matter under conditions of high humidity in temperate climates. Most peat bogs are formed from sphagnum mosses, heathers, sage, and grasses which are converted by bacteria and fungi. Perhaps the leading characteristic of peat is its great reluctance to part with any of its 90% water. Its millions of cells act as miniature water receptacles and *in situ* the water content of a peat bog may be as much as 95%. Peat is economically interesting because it requires only a little capital for its exploitation. Its by-products include peat moss, which is a valuable cattle litter and soil conditioner, peat coke, which contains less sulphur than other types of coke, peat tar from which may be obtained waxes, tar acids, and pitch, and "specialized" peat moss for the manufacture of insulating boards. Traditionally peat was dug by hand and stacked in sods to dry until ready to burn, but mechanical winning is now common. The two main processes produce, respectively, sod peats and milled peat. In each case the first task is to drain the bog. Ditching is done with machines having caterpillar tracks over 4 ft. wide. These ride the surface and cut main drainage trenches and must have a weight to bearing ratio of only 1 lb. per sq. in., which is about a quarter of that of ordinary caterpillar tractors. If sod peat production is to follow the surface of the bog is stripped and the peat excavated by a machine which cuts the material into sods by means of discs and leaves them spread in a single layer for from three to six weeks. They then are picked up

<sup>1</sup> *The New Scientist*, May 15, 1958.

mechanically, turned, and collected. Although mechanized the process depends on the weather and is seasonal, but in favourable conditions two cuts are possible in each season. After air drying the water content is down to some 55% so that each 10 tons of peat holds just over 5 tons of water. The second mechanical process yields milled peat and starts again with drainage of the bog and a series of three-day operations. In these a milling device cuts up the surface layer to a depth of  $\frac{1}{2}$  in. Harrows then accelerate the drying of the broken material which is ridged by bulldozers, picked up, and fed to the railway line. The end product carries about 55% of water and is highly inflammable; it must either be burned at the bog or briquetted for transport. Much research has been done in the attempt to improve the dewatering processes, but thus far full success has eluded the workers. Roughly five or six wagon loads of peat are equivalent in heat output to one wagon load of good coal, which makes peat expensive to transport; it is most economically used by conversion to electric power. Some power stations are now situated at the edge of the bogs in order to reduce fuel handling to the minimum. The peat oxidizes at between 150°C. and 200°C., releasing large quantities of volatile material which ignites at between 500°C. and 750°C. Such volatiles, which constitute about half of the fuel value, must be completely burned and the problem of distributing the air and regulating its quantity must be precisely handled. The usual furnace is the Makarieff shaft chain-grate, which includes a predrying shaft and a travelling grate, but good success has been obtained with the Mona jet burner, an Irish development which directs an air jet on passing a layer of fuel and sends the flame forward. Gas-turbine methods of use have been attempted but the deposition of ash on the turbine blading is a problem which has not yet been solved. Peat can be brought down to about 10% moisture by briquetting. The calorific value is then about 8,500 B.Th.U's which is comparable to the lower-rank grades of coal. Research continues in all countries having large quantities of peat and the huge deposits which are now estimated to total 120,000,000,000 tons make the substance of economic interest despite the expected cheapening of power production as uranium comes into its own.

Experiments in making titanium metal by reducing titanic chloride with sodium are described by the United States Bureau of Mines in a technical report released recently<sup>1</sup>. The report discusses metallurgical studies at the Bureau's Boulder City, Nevada, laboratories, where pioneering research developed the magnesium-reduction method now used by industry to produce titanium metal. Equipment and procedures employed by Bureau metallurgists in reducing titanic chloride with sodium at both low (97.5°C. to 200°C.) and high (1,000°C.) temperatures are described in the report. A detailed account is given of experiments in which reduction was accomplished in two stages with a special reactor.

\* \* \*

An important point in connexion with automation is the question of its reliability, which has a bearing on the safety of workers as well as upon process control. The liability to failure increases considerably with the number of components of which the automatic device is constructed. If, for example, it contains 20 units each of which is 99% reliable (defining reliability as a statistical average of one per cent. failure during the working life of the device), then the overall reliability is 0.99<sup>20</sup>. Every fifth such device should fail to function through the prescribed working life. If the device contains 500 parts, and only one is to fail out of every 200 made, each component must have a reliability such that only one in every 10,000 is liable (statistically) to fail. To achieve this high standard of reliability or below is by no means impossible with modern electronic equipment but demands exacting standards of manufacture, based on maximum simplicity of design, with moving parts kept to a minimum.

\* \* \*

Niobium first became "news" as the canning material used for the fast breeder reactor at Dounreay. It belongs, with molybdenum, tantalum, and tungsten, to a group of refractory or high melting point metals. Until recently niobium has been used in small quantities in stainless steels and non-ferrous alloys and even here its use has been restricted because supplies of ore were thought to be sparse. By 1954 growing interest in its applications had

<sup>1</sup> "Sodium Reduction of Titanic Chloride". *Rep. Inv. U.S. Bur. Min.* 5398.

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stimulated the search and large new ore supplies had been found. Reserves of niobium ores at present known are now estimated to be 127,000, 400,000, 500,000, and 53,000 tons of niobium pentoxide in Africa, Canada, Norway, and the United States respectively. It is possible that this group of metals will hold the key to the next phase of high-temperature aircraft materials development, since alloys at present in use appear to have reached their peak. Of the four niobium is at present most favoured for both nuclear and aircraft purposes. There are plenty of niobium, molybdenum, and tungsten ores, although perhaps not of tantalum ores, from which to choose and although niobium, like tantalum, is more difficult than the other two to recover, new processes, particularly chemical developments, would allow large-scale production. Niobium is the most readily worked of the four and in this is more closely resembled by tantalum than by the other two. It can be formed to thin-walled seamless tube and with precautions, be welded to form ductile joints. Niobium has a lower density (8.6) than tungsten (19.3), molybdenum (10.2), or tantalum (16.6), which is an advantage in aircraft-engine applications and a lower thermal neutron cross-section (1.1 barn) than any other high temperature strength metal. None of the group resists oxidation well, although niobium offers the best hope at present. The pure metal resists better than pure molybdenum above 1,000°C., so that a protective coating can be given in the knowledge that if it fails on impact reasonable safety is still ensured. It is possible, too, that niobium alloys will help to overcome the problem. Unlike molybdenum niobium has the important advantage of retaining its ductility over 1,000°C. Niobium is compatible with uranium and is expected to be compatible with plutonium, a useful combination for new types of reactor. The intensive research already in progress is likely to result in considerable improvements on the materials now in use.

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Prefabricated metal curtain walls for skyscrapers have assumed considerable importance recently. This was emphasized by the decision of an American company to use this type of façade in the new 38-storey office building now under construction in Fifth Avenue, New York. It will be the world's largest aluminium and porcelain-enamelled

aluminium-faced office building. The façade area is over 8 acres, enclosing more than 1,000,000 sq. ft. of office space. The design includes aluminium panels 12 ft. high by 7½ ft. wide, each containing a window and spandrel. Separating the panels will be white strips of 20 in. wide leaded porcelain enamelled aluminium, extending the full height of the building; the total weight of the façade is just over 375 tons. New developments in aluminium panel production and new methods of enamelling aluminium influenced the choice of materials. Lead compounds form a major constituent of the porcelain enamel used for this purpose and improve the smoothness and brilliance, as well as giving added elasticity and chemical resistance. Particularly important is the resistance to chipping provided by the lead content. Porcelain enamelled panels can now be sheared, sawn, punched or drilled during construction with little or no chipping of the enamel.<sup>1</sup>

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Tiny "bullets" of radioactive chromium metal, promising weapons in man's fight against cancer, are now available to medical science as a result of the United States Bureau of Mines research in metallurgy. The "bullets" are actually small metal cylinders— $\frac{1}{10}$  in. long by  $\frac{1}{30}$  in. in diameter—cut from fine strands of high-purity chromium wire. Exposed to neutrons in a nuclear reactor some of the atoms in the chromium cylinders are transformed into an isotope—Radioactive Chromium-51—which emits gamma rays in a manner similar to that of radium. The radioactive chromium cylinders have been used in experiments in animals in which they were either "shot" into cancerous tissue with a device called an implantation "gun" or they were first inserted in a hollow nylon thread and then sewn into a malignant area. Although other radioactive metals—such as, the radiocobalt and radiogold previously developed—are now being used in cancer therapy Chromium-51 appears to be the most satisfactory one for some purposes that has yet been developed chiefly because of its half-life of 28 days. This is ten times as long as that of the radiogold, which is inconveniently short for many purposes. On the other hand, it is only one-fourth as great as the 111-day half-life of radioactive tantalum that seems to be too long for implantation permanently

<sup>1</sup> *Lead*, Vol. 21, No. 1, 1957, p. 3.

into cancers in humans. Another attractive feature of the radioactive cylinders is the fact that they are not altered by body chemicals. High-purity chromium wire is made at Albany by a complex metallurgical process in which the wire is drawn through tungsten carbide dies while immersed in a hot-lead bath.<sup>1</sup>

\* \* \*

One technique in use as part of the International Geophysical Year's research programme in Antarctica is the drilling of ice cores. Technique and equipment both were first developed on the Greenland ice cap in 1956 and improved during 1957. A programme was begun at IGY's Byrd Station on December 16 last and it is being carried out by members of the U.S. Army Snow, Ice, and Permafrost Research Establishment of the Corps of Engineers. By January 26 scientists had reached a depth of 1,013 ft. with the drills. Ice cores taken from the drill holes preserve, by means of the annual layers, clues to the climate of Antarctica going back for many centuries. Because annual snow accumulation is relatively small in Antarctica the ice found at 1,000 ft. below the surface at Byrd Station is equivalent in age to ice taken from 2,000 ft. down in Greenland. The Antarctic cores, however, are more difficult to date. In Greenland the annual layers of snow are usually marked by a thin crust of refrozen summer melt, so that age can be read in the ice by rings like the rings of a tree-trunk. In Antarctica there is no summer melt, or a very slight one, and the annual layers are thinner and closer, so that a chemical analysis may be needed eventually to date the deep ice. The task of making the Byrd Station bores was begun by hand-boring a 3-in. hole 60 ft. deep. At this stage a cold compressed-air drilling rig with core barrels and bit designed for the purpose was put into service and since then a 4-in. diameter coring drill has been used. This equipment permits the removal of 15-20 ft. long cores intact. Compressed air, cooled to the required temperature so as to avoid damage to the sample by melting, is used to blow out the cuttings. Because of the great pressure at depths of more than a few hundred feet great care is needed to avoid shattering the ice cores when they are withdrawn from the deep bores. After withdrawal, each core is sliced in two.

One section is sent to Wilmette, Illinois, for examination by the research establishment's team there, while the other is melted and filtered to see if any particles or primitive organisms have been trapped in the ice. Volcanic ash from the Katmai eruption of 1912 was found in the Greenland ice and living bacteria were found under 90 ft. of snow at the South Pole. It is expected that similar ash and other matter, possibly of greater age, will be found at Byrd Station in the cores. The cores are broken into 3-in. lengths for density measurements, visual study, and wherever possible determination of annual accretion. Microscopic and photographic examination of thin sections of ice at different depths will make possible studies of crystal structure and a more accurate determination of the relation of age to depth.<sup>1</sup>

### Warren Spring Laboratory

The new D.S.I.R. laboratory being built at Stevenage is to be called the Warren Spring Laboratory. This new station, it will be recalled, is to be a "versatile" station, free to do work on any subject which becomes important for the nation and which cannot be fitted into the programme of another research body. It has already been decided that work will be carried out on air pollution, on the synthesis of oil and chemicals from carbon monoxide and hydrogen, and on mineral processing. In addition it is to be free to take up any research requiring staff and facilities of the type that are being provided.

## News Letters

### VANCOUVER

July 7.

**Transcontinental Resources, Ltd.**—Owing to low metal prices and other unfavourable factors Transcontinental Resources, Ltd., was less active than usual during 1957. General exploration and property examinations were undertaken in various areas of Canada and the United States, where, through a subsidiary, a group of 50 claims was staked in the Mattagami area of Ontario, as well as two gold prospects in British Columbia. Brikon Explorations, Ltd., in

<sup>1</sup> U.S. Bur. Min. PN 37986.

<sup>1</sup> *Comp. Air Mag.* Mar. 1958. p. 20.

which Transcontinental holds a substantial interest, staked five base-metal prospects in the Northwest Territories and two of these are under examination options to major operators.

In the annual report Mr. J. D. Mason, the company president, states that the most important project continued to be the open-pit copper prospect in Arizona, where development work during the year yielded favourable results. After the end of the financial year (in May) an agreement was entered into with two substantial American companies whereby they have taken over development of the property and agreed to spend \$350,000 in the next three years. When the total expenditure reaches \$1,000,000 these companies will be entitled to a 50% interest in the property and this interest will increase by 1% for each additional expenditure of \$100,000 until a total of \$3,500,000 has been reached. At that point Transcontinental Resources and associates will retain a 25% earned interest, which will not decrease further regardless of the ultimate expenditure of the operating companies. The optionees are entitled to return of capital from first profits.

The report expresses hope for the return of better conditions in the gold-mining industry and points out that Transcontinental stands to benefit through its substantial holdings in New Taku Mines, Ltd. (north-western British Columbia), Caribbean Gold Mines, Ltd. (Isle of Pines, Cuba), Crestaurum Mines, Ltd. (Yellowknife), Lynx Yellowknife Gold Mines, Ltd. (Yellowknife), South American Gold Areas, Ltd. (Brazil), Yukon Explorations, Ltd. (Yukon), and Noland Mines, Ltd. (north-western British Columbia).

**Yukon.**—The report of the Yukon Consolidated Gold Corporation, Ltd., for 1957 shows gold returns at \$1,934,843 (\$1,682,327) and gross operating revenue at \$1,966,297 (\$1,722,349); figures in brackets are for 1956. Income other than that from gold returns, power sales, and miscellaneous operating income includes \$12,908 (\$127,534) estimated to be recoverable under the Emergency Gold Mining Assistance Act, \$54,071 (\$40,122) interest on investments, and \$23,030 (\$7,772) profit on disposal of equipment. Operating expense was \$1,543,590 (\$1,353,727), head office expense, \$66,621 (\$70,311), depreciation \$91,989 (\$85,770), exploration, \$122,582 (\$74,956), and estimated taxes, \$4,000 (\$12,000). The net profit for the year was therefore \$227,524, as compared with

\$301,013 in 1956. A dividend of 6 cents per share on October 31 last involved distribution of \$357,114. Of the authorized capital of 8,000,000 shares of a par value of \$1 each, 5,951,851 shares have been issued and 44,804 shares have been reserved for issue in exchange for securities of former subsidiary companies.

Seven dredging operations recovered gold valued at \$1,822,580 from 6,283,046 cu. yd. of gravel and the hydraulic operation on Paradise Hill produced gold worth \$111,738. Yardage mined in 1957 increased substantially and the operating cost per cu. yd. accordingly declined from 25.01 cents to 22.71 cents. The recovery value unfortunately declined at the same time from 32.35 cents per cu. yd. to 29.01 cents. Proved gravel reserves at December 31, 1957, were estimated at 28,921,053 cu. yd. averaging 42.80 cents per cu. yd., in addition to 18,335,804 cu. yd. of partly-proved reserves on Bonanza Creek. Stripped reserves are estimated at 12,349,337 cu. yd. and thawed reserves at 9,446,973 cu. yd.

Exploration in 1957 did not disclose further potential dredging areas. In association with the Consolidated Zinc Corporation of Canada and the Asbestos Corporation, Ltd., Yukon Consolidated engaged in a staking and exploration programme in the Clinton Creek area of Yukon but no asbestos was found in commercial quantity. The company also engaged in the search for base metals in New Brunswick.

**Portland Canal.**—An extraordinary meeting of shareholders of the Premier Border Gold Mining Co., Ltd., has been called for July 15 to consider a capital re-organization calling for surrender of the 5,000,000 shares of the company at present issued on the basis of five shares for one in a company to be known as Calvert Gas and Oils, Ltd. The capital structure of the new company will then be expanded to 5,000,000 shares. The re-organization is expressly sought to enable the company to engage effectively in the development of the oil and gas industries. The company recently received \$45,000 through the sale of its Northern Lights mineral claims to Silbak Premier Mines, Ltd.

**Highland Valley.**—Craigmont Mines, Ltd., has entered into an agreement with a group consisting of Canadian Exploration, Ltd., Noranda Mines, Ltd., and Peerless Oil and Gas Inc., whereby the latter will be enabled to purchase a 60% interest in the 127-claim Craigmont property near Merritt. The



**Fort Saskatchewan  
from  
the Air.**

operators have subscribed for 100,000 Craigmont shares at \$2.40 per share, with Canadian Exploration taking half and the remainder split between Noranda and Peerless, and have made firm commitment to expend not less than \$500,000 in the development of the property within the next 18 months. At the end of that period the operators will be required to make further commitment for expenditure of a like amount in the ensuing 18 months, if the agreement is to remain in good standing. By the end of three years the operators will be granted a further four-year period in which to commence production. An active diamond-drilling programme has been conducted for the past seven months under the direction of Canadian Exploration. An immediate start will now be made on underground development.

Electro-magnetic surveys under the direction of D. H. Rae, have indicated seven areas of high readings on the 14-claim property of Torwest Resources, Ltd., south of the Craigmont property and surrounded on three sides by Noranda ground. Torwest is concentrating on the exploration of its most easterly claims, situated within a few feet of drill holes recently put down by Noranda. Torwest is optimistic concerning a farm-out agreement to Felmont Oils, Ltd., calling for the drilling of five holes on its

gas and oil leases north of Lake Erie in Ontario.

Jericho Mines, Ltd., has been advised by Anson Mines, Ltd., a wholly-owned subsidiary of the Phelps Dodge Corporation, that an active exploratory programme will be conducted on the Jericho group of 1,000 claims in the Highland Valley. During this summer a minimum of six deep drill holes will be put down, in addition to geophysical surveying and surface trenching and stripping.

During the past two months Bethsaida Copper Mines, Ltd., has carried out line-cutting, prospecting, and reconnaissance geological and magnetic surveys on its 26-claim property adjoining the Craigmont prospect. The directors have agreed to suspend the work temporarily until some information is obtained from the extensive work being done by Craigmont to the west and south-west and by Noranda to the north.

Skeena Silver Mines, Ltd., has maintained its Divide group in the Highland Valley in good standing since suspending work last winter. The work will be resumed when better copper prices warrant. The company's original silver-lead property at Skeena Crossing is also being maintained in good standing. Rio Canadian Exploration, Ltd., has stopped work and forfeited its option to purchase Skeena Silver's 24-claim prospect in the Mystery-Moak Lakes area of Manitoba.

Skeena Silver has recently invested nearly \$50,000 in Alberta oil development, but at last report the directors had agreed to go no further in this respect.

**Osoyoos.**—French Mines, Ltd., a subsidiary of the Cariboo Gold Quartz Mining Co., Ltd., produced 525 oz. gold in the first 15 days of June. The ore was particularly high in grade and for two days heads exceeded two ounces per ton.

**Nelson.**—The consolidated net profit of Placer Development, Ltd., and its wholly-owned subsidiaries has been estimated at \$2,500,000, equivalent to 97 cents per share, for the year ended April 30, 1958. This compares with \$3,599,000 (\$1.39 per share) in the previous year. Canadian Exploration, Ltd., the subsidiary operating lead-zinc and tungsten mines at Salmo, earned an estimated net profit of \$1,117,400 in the period, as compared with \$1,672,300 in the previous 12 months. In the final quarter Canadian Exploration recovered 7,027 tons of lead and zinc concentrates from 93,552 tons of ore grading 1.64% lead and 3.70% zinc and produced 25,899 units of tungsten concentrate from 27,876 tons of ore assaying 1.05%  $WO_3$ . For the full year production was 31,495 tons of lead and zinc concentrates from 409,138 tons of ore grading 1.48% lead and 3.93% zinc and 96,927 units of tungsten concentrate from 151,441 tons grading 0.74%  $WO_3$ . The estimated gross operating profit of Canadian Exploration was \$3,010,200 (\$3,971,000); write-offs included \$367,000 (\$202,500) for exploration, \$800,000 (\$1,341,400) for depreciation at maximum income-tax rates and depletion on a tonnage-cost basis, and \$725,800 (\$754,800) for Dominion and Provincial taxes.

**Slocan.**—During the year ended April 30, 1958, the Western Exploration Co., Ltd., recovered 240,897 oz. silver, 1,799,082 lb. of lead, and 2,147,210 lb. of zinc after treatment of 17,182 tons of ore grading 14.0 oz. silver per ton with 5.2% lead and 6.2% zinc. The operating profit before depreciation and depletion was \$50,206, less than the \$62,672 earned in the previous fiscal year despite the fact three times as much ore of even better grade was mined and milled. The decline was attributable entirely to the fall in metal prices. During the same period 9,625 tons of custom ore was milled; the value of production was \$397,878, less \$20,202 handling charges. Other revenue consisted of \$59,229 from

custom milling, \$628 from royalties, and \$2,135 from miscellaneous sources. The net income was \$1,622 after provision of \$24,014 for depreciation and \$24,570 for depletion.

## TORONTO

July 15.

**Gold Production.**—During May the gold mines of Ontario milled 801,102 tons of ore and recovered 228,123 oz. of gold and 37,535 oz. of silver valued at \$7,745,425. In the month the average grade of ore was \$9.67 per ton and the average number of wage earners 10,904.

**Geological Survey.**—This year 77 parties from the Geological Survey of Canada, representing a working force of nearly 360 persons, are heading into the field. The year's programme consists of a series of projects ranging from submarine geology of the continental shelf, exploration in the western Arctic islands, and reconnaissance in the mountains of Yukon, to stratigraphic studies in Western Canada and a study of the surficial geology around the proposed site of the South Saskatchewan dam; every province and the two territories are included. The first systematic survey to be undertaken over Canada's continental shelf will aid in outlining the geology of the Gulf of St. Lawrence and Decca navigational equipment will be used to control this extensive submarine survey. Only recently Canada received international recognition of its right to exploit any mineral deposits which might be present in the continental shelf surrounding its shores.

Preparations are to be made this field season for three large aircraft-supported operations projected for 1959 to survey perhaps 205,000 sq. miles of Canada's north. Two of the 1959 projects—Operation Pelly, in Yukon, and Operation Coppermine, in Northwest Territories—will have helicopter support; the third will take geologists to Banks and Victoria Islands in the Arctic Archipelago. This season geologists are to use a light aircraft to explore Melville, Brock, Borden, and Mackenzie King Islands in the western Arctic. At the same time Operation Fort George, started in Quebec in 1957, will be continued. Using a helicopter a party will map about 35,000 sq. miles in an area between James and Hudson Bays and the Labrador Trough.

**Kirkland Lake.**—Development at Wright-Hargreaves Mines has recently shown very good results, particularly in the six new levels between the 7,350-ft. and 8,100-ft. horizons. There driving over 1,750 ft. has proved 72% payable, the ore averaging better than 0.70 oz. per ton (\$24.50 at \$35 gold) cut grade across the drive width of 5.5 ft.—almost double the average mine grade. This should lengthen the life of a veteran producer for some years. The company expects that net profits this year will be over \$500,000.

**Saskatchewan.**—The report of Rix Athabasca Uranium Mines for 1957 stresses the fact that record production was obtained, while at the same time development was accelerated in both shafts. The results have given some cause for optimism as to the future production potential of the mine, it is stated, and capital expenditures have been approved to put the operation on a more permanent and efficient basis. In December last the company completed its contract with Eldorado several months ahead of schedule, but the company has signed a further contract which will be completed in the first half of 1958. It is stated that a custom milling contract is being negotiated with Lorado Uranium Mines, Ltd., and approximately 500 tons of ore were shipped as a trial run during February, 1958; shipments were continuing in March and an increased scale of operation is anticipated for the current year.

**Quebec.**—On July 23 Aluminium, Ltd., stated that a curtailment of about 10% in the rate of primary aluminium production at its Canadian smelters has been decided. From about August 1 its principal subsidiary—the Aluminum Co. of Canada, Ltd.—is to reduce its annual production rate from the present 620,000 tons per year to about 560,000 tons. The new rate is about 72% of installed smelter capacity of 770,000 tons per annum. The company stated that, while its volume of sales in the second quarter this year increased 15% over the first quarter, the year's production to date has been considerably above the level of sales. Curtailment is, therefore, being made at this time to bring production and sales more closely into balance. Approximately 400 smelter employees at Kitimat, Shawinigan, and Isle Maligne will be affected.

In an effort to deal with the situation created by the decline in base-metal prices East Sullivan Mines has asked its employees to take a 20% reduction in pay. Unless this

proposal is accepted the company is to suspend mining operations. The company is at present operating at a loss of around \$70,000 monthly it is stated.

Also as a result of present conditions Coniagas Mines has deferred bringing into production its Bachelor Lake property, where a shaft has been sunk to a depth of 1,350 ft. and five levels established above the 775-ft. level. Some 407,000 tons of ore, grading 15.7% zinc, 1.04% lead, and 8.77 oz. silver per ton, have been outlined above the 625-ft. level.

For the first three months of the current year Opemiska Copper Mines had a net loss of \$172,055. Production was valued at \$1,221,490 and the daily average mill rate was 813 tons. At the end of the quarter the milling rate was around 1,000 tons per day. The company is at present engaged in a construction and development programme designed to increase the rate to 2,400 tons per day by the beginning of 1960.

## MELBOURNE

July 21.

**King Island Scheelite.**—The fall in the price of tungsten, the expiration of contracts with the United States, and the very unfavourable outlook on the world's tungsten market have caused the King Island Scheelite (1947) company to decide to close down the mine on August 2 in order to minimize loss and avoid depletion of the company's strong financial position. Until the market improves, the mine will be on a care and maintenance basis, so that work can be resumed as soon as the position warrants. Present operation on the current price for mineral and existing demand on the open market is unprofitable. In the meantime the company's income must come from outside investments which stand at £A389,727 in company shares and £A539,000 in short-term securities. The company is the largest scheelite producer in Australia and is considered to be the world's largest scheelite mine. It is worked by open-cut and has been producing about 264,500 tons of ore per year; grade of ore mined in the last year was 0.482% tungstic acid and concentrate recovery was 1,437 tons in the period. A substantial sum has been spent in overburden removal and in plant improvement, which it was hoped might counter a fall in the tungsten market to some extent; the ore reserves approximate

2,000,000 tons. King Island Scheelite, in association with other companies, has been searching for minerals in other parts of the Commonwealth, but just how far this policy may now be continued remains to be seen.

**Hill 50 Gold Mine.**—The Hill 50 mine, on the Mount Magnet goldfield, is one of the rich mines of Western Australia. Following a re-adjustment of ore reserves with increasing depth, however, general policy has been modified with the object of maintaining profits in the face of decreased grade at lower levels. The dividend has now been reduced from 1s. 10d. per share to 1s. 5d. for the year ended June 30, 1958. This rate of dividend will require the distribution of £A637,500, bringing the total payments to £A4,703,252. Work has been proceeding to increase mill throughput by erecting additional plant. Underground development appears to be maintaining tonnage of ore reserves ahead of the mill, but there has been a fall in values on recent estimates. Despite this the mine continues to be a high-grade proposition.

**Broken Hill.**—The fall in the world market for lead and zinc is being severely felt in Broken Hill and the position emphasizes the high level that costs must have reached in the years of prosperity. The state of over-production in the world prompted a reduction in output of 10% in an effort to stabilize prices. This was done by reducing the 10-day working fortnight to nine days, but this policy may be defeating itself for recent figures show a slight reduction only in tonnage raised, evidently showing that miners are trying to maintain their earnings by greater production, while grade of ore has increased. A very adverse factor in mining costs under prevailing conditions is the lead bonus, which is based on the market price of lead and not on profits. As the present agreement has something less than three years to run any prospect of modification in the conditions governing the lead bonus is remote: at present the bonus represents the payment of about £A8 per full week worked.

Following the action of the mining companies the Broken Hill Associated Smelters, Ltd., at Port Pirie, has reduced output of lead bullion by 15% as a contribution to reduction of the excess in world supply over demand. This company is jointly owned by the Consolidated Zinc Corporation, £750,000, North Broken Hill, £546,578, and

Broken Hill South, £203,424, in the total capitalization of £A1,500,000. In 1957 the four Broken Hill mining companies—the three mentioned above and New Broken Hill Consolidated—earned £A12,000,000 less than in the previous year, in which reduction in revenue the main factor was the fall of £50 per ton for lead in the world markets. This fall was responsible for a drop of £A1,800,000 in the lead bonus paid to 6,000 employees. Since the nine-day working week has come into operation the wages bill of the four companies has decreased by £A750,000.

**Mineral Production.**—Despite the fall in prices for base metals Australian production was maintained at a high level in 1957. Mineral exports, excluding gold, were valued at £A69,600,000, which was slightly higher than in the previous year. A notable feature was the revival in the coal export trade, which had practically ceased over a number of years because of organized labour trouble on the coalfields; in 1957 this trade reached a total of 759,000 tons. This was in part due to the recognition by the miners that their livelihood was in serious danger from the old policy of unrest and partly to reduction in cost of production from extensive mechanization and modernization, with a resulting increase in output per man shift. Lead was the most important export, valued at £A32,237,000, zinc exports were worth £A9,234,000, rutile £A8,617,000, copper £A7,130,000, and coal £A3,232,000. Coal production in 1957 reached a record of 19,799,000 tons for black coal and brown coal totalled 10,741,000 tons.

The country has some substantial mineral imports, which last year were valued at £A78,000,000, of which crude oil cost £A63,300,000, phosphate rock £A2,600,000, asbestos £A2,400,000 and aluminium £A2,200,000. The figures show how important a substantial oil discovery would be to the Australian economy. The demand for asbestos could be met to a considerable extent by more intensive utilization of blue asbestos fibre, of which Western Australia holds very large potential reserves; possibilities for chrysotile asbestos are not so great, but there are occurrences of this fibre that might well repay exploration. Actually, interest in the mining of local chrysotile is increasing and it is not unlikely that this interest may be stimulated by Government influence. Phosphate rock is one of Australia's essentials; local production of

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**Beach-Sand  
Operations,  
New South Wales.**

phosphatic material is negligible and the large domestic need is met from the Pacific islands. As regards aluminium, recent discoveries of bauxite promise that in the not very distant future home requirements can be met and an important export trade established.

**Mount Morgan.**—Mount Morgan, Ltd.'s, output of gold and copper increased in the year ended June 30, 1958. Gold production was 51,057 oz., as compared with 37,716 oz. in the 1956-57 period and 47,655 oz. in 1955-56. The copper output was 7,424 tons, against 5,470 tons and 6,604 tons in the two previous periods. The mill treated 875,350 tons of ore, against the previous year's total of 738,300 tons. A statement of profit for the past year has not been issued yet, but the trend in operations is shown by a fall in profit from £A555,283 to £A23,807 in the year 1956-57. With the increased production in the last financial year an improvement in the financial position is to be expected and this should be improved still further in the current year as the Government assistance to the copper-mining industry becomes increasingly apparent. The company considers that this assistance will permit profitable operations and if the inquiry into the Sulphuric Acid Bounty produces a favourable report, the company expects that the position will become reasonably satisfactory in the present depressed circumstances.

2-6

**Peko Mines.**—This Tennant Creek mine is the only copper producer in the Northern Territory. It has developed ore reserves of over 1,000,000 tons of good grade, being rather over 6% copper, with a useful contribution from gold. The mine is in the satisfactory position that it qualifies for assistance under the Commonwealth bounty scheme and although its participation will be below the maximum the amount received will be useful. The company is adversely situated by the necessity to transport all copper concentrate some 2,500 miles to a smelter, for smelting on the field does not seem to be regarded favourably from the economic aspect. The company has been interested in examining outside mineral occurrences and recent diamond drilling on the Orlando lease, on the western side of the field, has intersected ore assaying 26 dwt. gold per ton over a reported true width of 22 ft. The intersection is at a depth of 400 ft. from surface and as this is about the maximum depth to which gold deposition has so far been proved to extend on the field and as auriferous shoots have usually been short considerably more work must yet be done before the importance of the discovery is established. Previous exploration at shallow depths did not disclose anything of importance. The lease contains two or three anomalies located by geophysical prospecting and as gold is associated with these haematite masses—although the haematite

itself is not auriferous—throughout the field, prospecting is warranted.

**Uranium.**—The South Australian Government-owned uranium mine at Radium Hill has earned more than £A5,367,000 by the sale of uranium oxide to the United States and has netted £A3,125,000 from its sales to the United Kingdom. The Government has a firm contract with the Combined Development Agency, comprising the governments of Great Britain and the United States, for the sale of the output of uranium oxide until the middle of 1961. This will mean a return of about £A3,000,000 per year for the next three years before the State will be forced to enter the world's competitive market for the sale of its product.

The development of Radium Hill followed rapidly on the commencement of the uranium boom. The occurrence of radioactive ore there had been known since the first decade of the century, when a small quantity of ore was produced for extraction of radium. The locality was examined at the same time as the Mount Painter field, in the Flinders Ranges, discovered about the same time, but when investigated early in the uranium boom the former field was soon seen to hold superior evidence of continuity of occurrence and permanence. The ore is davidite and is concentrated on the mine for consignment by rail to the chemical treatment plant at Port Pirie, where uranium oxide is produced. The country to the north of Radium Hill holds encouraging prospects of containing commercial occurrences of importance. Concurrently with the development of the mine and treatment works the South Australian Government equipped what is considered to be the best laboratories for the examination of uranium ores in Australia and this was speedily supplemented by a pilot plant capable of dealing with the variety of ores opened up in the several parts of the country.

At the Mary Kathleen mine, in the Mount Isa-Cloncurry district, a recalculation of ore reserves has shown that the ore is slightly lower in grade than had been originally estimated, but that the tonnage of uranium oxide in the lode is greater and will be in excess of the quantity required to complete the original contract with the United Kingdom Atomic Energy Authority. It has been announced that uranium oxide concentrate is now being produced by the mill and the first container has been packed for shipment to Great Britain. The start-up of the mill is described as having been very smooth and

it is not expected that problems that will naturally arise will present any major difficulties.

**Oil Search.**—The urgency of oil search in Australia is recognized in some quarters, but lack of encouragement has dampened the early enthusiasm of the investing or speculating public. A recent report is to the effect that Humber Oils, Ltd., of Canada, has been granted a permit to search for oil over 53,000 sq. miles along the Barrier Reef from Gladstone to near Townsville and also over a small area north of Townsville, Queensland. Stratigraphic wells will be drilled to explore the formations below the reef.

Some drilling is in progress by Australian interests in the Gulf of Carpentaria country, but the chief activity on the mainland is the work of West Australian Petroleum in Western Australia. There has been no success since the initial sensational discovery over four years ago, but the company has an extensive programme planned. In New Guinea drilling is being continued, the most encouraging results being the recurrence of heavy flows of gas which, however, have not yet led further.

**Australian Development Mine.**—This Northern Territory gold property continues its excellent development record and maintains its position as the country's richest gold mine. Long-hole drilling underground has been adopted as a regular method of prospecting and the following are results from drill intersections recently reported; at the 165-ft. horizon, 29 dwt. gold for 50 ft.; 17 dwt. for 15 ft.; 17 dwt. for 15 ft.; 29 dwt. for 10 ft.; 23 dwt. for 15 ft., and 21 dwt. for 20 ft. Despite high costs, excellent profits continue to be made; minimum grade of ore to the mill is about 7 dwt. gold per ton. So far no gold of importance has been located below a vertical depth of 300 ft., but lateral extensions, still undefined, continue to keep reserves ahead of extraction.

**Pyrite for Sulphur.**—West Australian pyrite production, it is now evident, has become an established industry, first with the Norseman pyrite mine (Norseman Gold Mines, Ltd.), and more latterly from the Golden Mile, "which could have a large potential." For the year ending June 30 last Norseman produced 50,000 tons, value given as £A345,000, whereas Kalgoorlie's total was 19,000 tons for the stated value of £A154,000. These figures are likely to show an increase.

## FEDERATION OF MALAYA

July 15.

**Mining in Malaya.**—A Commission recently appointed to investigate land administration has suggested that tin mining, which has done much for Malaya, is capable of doing much more, although "it would seem that great and increasing administrative difficulties are being put in its way." A report by the Commission placed before the Federation of Malaya Legislative Council says that a certain amount of prejudice seems to be mounting against tin mining and that if it is not removed it may do Malaya much economic harm. It is pointed out that "active encouragement and not prejudice is needed to take advantage of men, money, and materials which are available for mining operations." The mining industry would decline unless it was helped to find and obtain suitable tin-bearing lands to replace worked-out mines. The report also contains a recommendation that a permanent committee should advise state governments on mining land; reference to such a committee would be needed only in cases where there was a conflict of interests or a divergence of views between departments. According to the Land Administration Commission there should be an implied right to renew a mining lease on expiry, the term of renewal to be sufficient to permit the remaining mineral to be extracted. Unreasonable rehabilitation conditions should not be imposed on new leases, it is suggested. The cost of rehabilitating mining land should be defrayed from a Mining Lands Rehabilitation Fund, which the Federation Government intends to set up, financed by a small cess on all tin exported.

**Tin Industry.**—The suggestion that Russia should join the International Tin Agreement has been welcomed in Malaya. Both Mr. Chong Khoo Lin, president of the All-Malaya Chinese Miners' Association, and Sir Douglas Waring, who represents mining interests in the Federation of Malaya Legislative Council, have expressed approval.

About 40% of the tin mines in the Federation of Malaya have been closed down since production was restricted last December. Figures for May show that 110 tin mines shut during that month, leaving 447 mines

working; at the end of last December 738 mines were operating. Some 9,600 workers have lost their jobs since December, while export figures for the first half of 1958 show that they are the lowest in 10 years. During the January to June period this year the exports total was 25,960 tons—a drop of 28% compared with the corresponding period of 1957. Traders supplying machinery and hardware to mines report in Ipoh that business is almost at a standstill.

The Federation's 7,953 dulang washers have been ordered to sell only 15 katies of tin ore concentrates a month instead of the former 25 katies, a restriction imposed by the Federation Mines Department because washers have been exceeding their allocations. Mr. A. W. Burne, Senior Inspector of Mines, Northern Region, has said that dulang washers had been over-producing in the first and second quota periods. They were allowed a total of 7,272 piculs, but sales amounted to 12,900 piculs. Many dulang washers have appealed to the Malayan Chinese Association against the cut, saying that the sale of 15 katies of tin ore concentrates is insufficient to support their families.

Following the discovery of what is described as a "tin-rich" area in the Kuala Selangor district a proposal has been made that a railway line should be constructed to link Batang Berjuntai with Batu Arang, where Malaya's only coal mine is situated. (There was a line which was taken away by the Japanese when they occupied Malaya.) The District Officer, Raja Azam bin Raja Kamaralzaman, is quoted as saying: "We have discovered real wealth in this district—tin and probably other minerals. It is, I should say, one of the richest potential areas in the country."

**Sarawak.**—The first export of bauxite has been made from Sematan, in Sarawak, Borneo. It consisted of a load of about 8,500 tons, which was shipped to Japan. Another shipment from this Sematan Bauxite, Ltd., project was due to follow soon afterwards—6,000 tons of ore to Formosa, which has placed an order for 50,000 tons. The bauxite deposits were located at Sematan—which is in the Lundu district of the First Division of Sarawak—in 1949, but are only now being developed. These deposits are believed to be capable of producing 2,500,000 tons.

**Hong Kong.**—A number of mineral deposits have been found in the New Territories

of Hong Kong, according to the colony's current Directory of Commerce, Industry, and Finance. The Ma On Shan iron mine was first prospected in 1906 and "has been operating successfully since 1949." The mine is under re-organization from open-cast to underground mining and it is estimated that when conversion is complete there will be a movement of some 700 tons of ore a day from the mine. New ore-dressing plant, capable of concentrating from 500 tons to 700 tons a day of magnetite ore to 62% Fe, is now engaged on the low-grade dumps which had accumulated since the mine began to operate in 1949. All ore was exported to Japan. Prospecting for iron ore continued in other parts of the New Territories "but so far with indifferent results."

A lead mine operated before the war is also being re-organized and the main adits, tunnels, and cross-cuts are being cleaned. The ore recovered is hand-picked and exported to Europe; several other areas in the New Territories were being prospected for lead outcrops.

Of other minerals a graphite mine on a small island known as the West Brother continues to yield amorphous graphite of a quality much in demand, particularly in the United States; two other areas are being prospected for graphite. In addition three wolfram areas are being actively prospected, while the search for kaolin deposits has shown an increase; the output from deposits at present being worked is sent principally to Japan.

Beryl has recently been discovered in two areas of the colony, one of which is being prospected; beryl crystals have been shipped to the United States for a complete breakdown and assay.

Power to grant prospecting and mining licences is vested in the Commissioner of Mines. Prospecting licences may be issued for a total period of two years and mining licences for not more than five years, renewable every six months. Mining leases may be granted up to a maximum of 21 years by the registrar-general.

**China.**—Experts from China and Russia are planning to set up a number of mining centres in the Amur River area of Manchuria, where "rich mineral resources" have been discovered, according to recent reports from Hong Kong. Wide-scale winning of gold is to be undertaken by the Chinese in Manchuria, as well as in Mongolia, Sinkiang, Kwangsi,

and Yunnan, while three new gold refineries are to be established in Mukden.

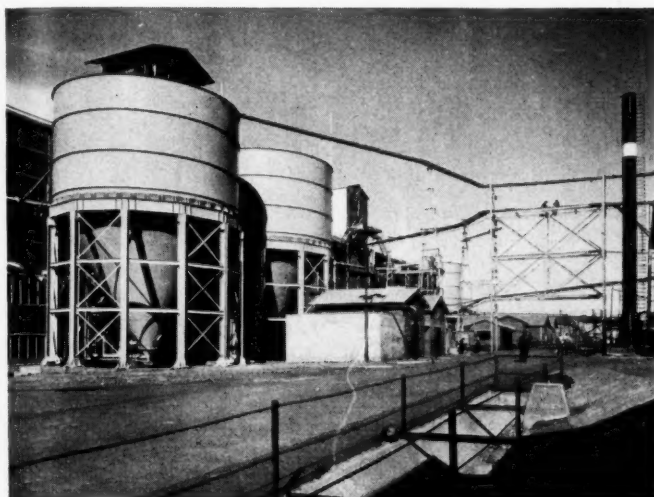
**Pakistan Oil Hunt.**—The Tidewater Oil Company, of Delaware, U.S.A., has signed an agreement with the Pakistan Government for an oil search over about 10,000 sq. miles, the area to be covered being in the southern and south-eastern portion of West Pakistan. Under the agreement, it is reported, the company is to pay 75% of the initial exploratory and development expenses and Pakistan 25%. There is provision for a 50-50 distribution of profits derived by the company from the production of oil, while Pakistan will be entitled to receive 25% of any oil found. Geological and geophysical surveys will begin shortly and it has been agreed that Pakistan nationals should be trained by the company for all phases of work associated with the search for oil.

## JOHANNESBURG

July 27.

**Marginal Mines.**—The special committee which at the instigation of the Government investigated the problems of the marginal gold mines has submitted its findings to the Minister of Mines. Details have not yet been released but opinion is inclined to the view that the findings may not be very hopeful. However, it is certain that every effort will be directed towards prolonging their lives and staggering their closures in order to minimize dislocation in the relevant areas. The report will be published in due course. The number of mines investigated was about 14, which have not yet been officially classified.

**Union Economy.**—In 1957 the Union's deficit in the balance of payments of about £13,000,000 was attributed by the South African Reserve Bank mainly to a net outflow of capital amounting to £18,000,000, after allowing for a net inflow of official and institutional capital of about £9,000,000. The overall net outflow of private capital was therefore about £27,000,000, accounted for mainly by net loan repayments, net purchases of securities, and net foreign investments, associated chiefly with the high interest rates and the credit squeeze in the United Kingdom. In the first 1958 quarter the emphasis was changed. Higher imports accounted for most of the increased deficit in



**Pulp Stocks  
at a Rand  
Uranium Plant.**

the balance of payments, a tendency that has persisted in the second quarter. Against the payments deficit of about £41,000,000 in the first quarter loan receipts amounted to about £21,000,000, reduced to £20,000,000 by commercial bank transactions. The net outflow of private capital declined by about £3,000,000 estimated, two-thirds being attributed to purchases of Union securities. At the end of December, 1957, the gold and exchange reserves stood at £101,976,000; by June 30 they had declined further to £76,118,000 in the region of which they still stand. Measures introduced to conserve the reserves have included banning imports of high-priced cars, raising commercial bank reserves with the central bank, stricter controls on foreign exchange transactions with the sterling area, tighter hire-purchase terms in the motor trade, higher short-term interest rates, and higher yields on open-market prices for Government stock.

In the course of his recent Budget address the Minister of Finance, the Hon. J. F. Naude, commented that the 1957 census of external assets and liabilities of the Union showed that income from the country's investments abroad had become considerable (£12,000,000 in 1956) and that the country in that year invested £20,000,000 abroad, of which £14,000,000 went to the Central African Federation. The conclusion drawn is that this external investment in particular (as well as external investment in the Union),

had a more marked effect on the balance of payments than previously recognized. This outflow of funds therefore disguised the real dimensions of the inflow of capital, which in 1956 actually was £33,000,000 instead of the net amount of only £1,000,000 as reflected in the statistics of the balance of payments. On the question whether the Government should not perhaps have resorted to the expedient of intensified import control to arrest the decline in the gold and exchange reserves, the Minister affirmed that such control could only suppress problems at the risk of rising prices and costs, that in any case it was not quite fashionable, being at best merely a stop-gap and regarded by the International Bank and International Monetary Fund with disfavour. The Government will have to raise £18,000,000 in external loans in the current financial year, a substantial portion of which is hoped to be obtained from the International Bank. If the financial and monetary measures taken to improve the balance of payments are not fully effective application for a further standby credit from the I.M.F. will be made rather than the application of direct import restrictions. The hardening of internal interest rates and, in particular, the reduction in the United Kingdom rate to 5% should encourage South African traders to retransfer credit from domestic to the U.K. banking system and South African subsidiaries of U.K. companies to retain funds in the Union rather

than transfer most of these to the U.K., thereby improving the balance of payments position especially over the next 12 months. Consumption, however, must be held in check both to contribute to that improvement and to encourage savings and thereby provide funds for the continued high level of capital expenditure on the loan account. Financing this expenditure remains the main budgetary problem, especially on long-term services and particularly on the railways and harbours, for which expenditure will be raised by nearly £16,000,000 to £75,000,000, while other expenditure, especially on defence, has been reduced partially or substantially or as in the case of non-recoverable or short-term expenditure been transferred to the revenue account. Special measures to cover loan account expenditure (which will rise by £23,000,000 to £146,200,000) will be the continuation of the 1957 savings levy (which includes an extra 6d. per £ on the taxable income of companies, diamond mines, and other mines, excluding gold and gold-uranium) and the issue of five-year non-transferable bonds to a maximum of £10,000 carrying 5% tax-free interest to individuals; the massive contribution of £26,500,000 will be transferred from the revenue account. Reduced expenditure on the defence vote has been facilitated by the revenue appropriation of £5,000,000 which has been effected for some years to equip a task force and which is no longer necessary.

In answer to allegations of malpractices in the conduct of the affairs and finances of the gold-mining industry in a request by a Nationalist Party member that there should be an inquiry into the industry, the Minister of Mines has rejected such a request at the present time. He added that the industry did not constitute a harmful monopoly and never could be this because the gold price was fixed and because, in any case, the liaison between the industry and the Government was too close.

**Chamber of Mines.**—In his recent address to members of the Transvaal and Orange Free State Chamber of Mines<sup>1</sup> Mr. H. C. Koch, the retiring president, referring to the question of taxing uranium profits on the same basis as gold, said that the result of the investigation into this matter is still awaited and that the S.A. Atomic Energy Board transfers to the Treasury 6d. per lb. of uranium oxide sold in addition to the usual tax.

<sup>1</sup> See the July issue, p. 3.

While the European shortfall of labour has largely eased, said Mr. Koch, the numbers being trained as miners are insufficient and there is a general shortage of technicians, engineers, and scientists. Every year the industry needs an intake of at least 1,000 miners, whereas at the training schools the number completing their training is only between 600 and 700. Insufficient domestic recruiting necessitates the continuation of overseas recruiting, which generally is working well. The education and training of engineers and scientists is being encouraged and supported financially by the industry, but the outflow from the universities has remained more or less constant over the last 10 years and no appreciable progress can be expected until the Government tackles the matter on a broad and national basis. The problem in the native labour complement is also numerical, more particularly in regard to its seasonal fluctuation. Over the remainder of 1958 there are hopes that the seasonal decline may be less pronounced than previously. Peculiar to the large proportion of "tropical" natives employed by the industry is that they arrive and leave in large batches. This affects certain mines more than others.

**Transvaal.**—Shaft-sinking at East Rand Proprietary Mines, Ltd., on the East Rand, has now reached the depth of 11,000 ft, considered to be the deepest in the world. At this depth the rock temperature is 123° F. which is reduced to bearable limits below 92° F. by ventilation and refrigeration. However, the mine is faced with the need to overcome such high rock temperatures, the ever-present possibilities of pressure bursts, and high costs which could become excessive. Long-wall stoping methods and destressing of the stope faces by moving beyond the immediate face the stress zone and thereby preventing it from developing into a fracture zone are minimizing the danger of pressure bursts in the workings. Light detonation in destressing holes during the off-shift cycles is the method in use.

The South African Iron and Steel Industrial Corporation, Ltd., has now commissioned its fourth blast-furnace, which, with an output capacity of 10,000 tons of pig-iron a week, is reported to be the largest in Africa. The combined capacity of the three furnaces previously in commission is 12,500 tons a week.

The Minister of Mines, in a reply to a letter from Klerksdorp Consolidated Goldfields, Ltd., has stated that it will not be possible



**4-ton Trucks  
Underground at  
Rustenburg  
Platinum.**

to admit the company as a producer of uranium oxide in the present contract with the Combined Development Agency owing to the recent ceiling placed on supplies under the contracts. The Minister added that the South African Atomic Energy Board is exploring the possibility of finding additional markets for uranium in countries other than those represented by the Agency, but cannot state when it will be possible to admit the company to the uranium production programme. The company is therefore placing its partly-developed property on a caretaking basis, is reclaiming all development equipment, which will be sold, and is taking up a restricted interest in another mining venture.

Afrikaner Lease, Ltd., which has been opening up a new section where uranium values of 153.4 in.-lb. and 314.1 in.-lb. of  $U_3O_8$  were obtained from the upper and lower reefs in the second quarter, has applied for an increased output quota and, pending the reply, has now suspended development in that section. So far the quota has been fixed at the 1957 level of output. While the fact that the company is already a designated uranium producer may add weight to its application, the answer received by the Klerksdorp Consolidated company cannot be a happy augury for the Afrikaner company's application.

Middle Witwatersrand (Western Areas),

Ltd., which has a 28.9% interest in the Zandpan gold mining company and a 6% interest in Feralloys, Ltd. (a ferro-manganese project on the verge of production), has completed one bore-hole in the prospecting area east of the Hartebeestfontein mine in the Klerksdorp area and is continuing the drilling of two other holes. Formations disclosed in the completed hole indicated that, if present, the Vaal Reef or any other economic horizons were at too great a depth.

Mineral Holdings, Ltd., the subsidiary of Henderson's Transvaal Estates, has sold the mineral rights of the farm Zandfontein 128 in the Bethal area and coal rights over two farms in the Free State. The subsidiary retains the mineral rights over 684,370 acres in the Transvaal and 752,799 acres in Swaziland. The Consolidated Investment Co., Ltd., which is prospecting in Swaziland for gold, coal, and base minerals, has an option to purchase certain of the mineral rights owned by Mineral Holdings in the Protectorate.

**Orange Free State.**—The central and southern Free State is now again receiving prospecting attention and preliminary surveys have been and are being conducted for surface indications of possible mineral occurrences. One company, Exploratory Investments, Ltd., is reported to have taken up options over a vast area north and north-west of Bloemfontein in the Brandfort, Dealesville, and Bultfontein districts, which are in the

vicinity of the diamond fields and of known salt and gypsum deposits. More to the south, between Bloemfontein and the Orange River, university teams have been reported as having been out on field surveys in an area in which a bore-hole disclosed at depth an occurrence of a complex ore of nickel-copper-gold and the platinum-group metals. The survey has a general rather than specific objective.

Roberts Victor Diamonds, Ltd., the resources of which are inadequate for the resumption of large-scale operations, is advancing development for small-scale production at its mine in the Boshoff area of the western Free State, while endeavouring to raise additional capital for larger-scale output. The latter would involve the stripping of overburden and the removal of accumulated debris in the Kimberlite pipe or fissure, which has been intermittently worked from 1906, and the resumption of large-scale open-pit operations. The caving-in of overburden and debris has interrupted operations now in progress and to avoid the recurrence of this a small shaft is being sunk from the open-workings and within the next few months will be completed and connected with the Kimberlite by means of a cross-cut. The mine is representative of the few small but high-grade diamond producers proclaimed in the early days of this century in the Boshoff area, which lies to the east of the major diamond mines of the De Beers group.

The plant of the South African Coal, Oil, and Gas Corporation in the Northern Free State, which has an output capacity of nearly 70,000,000 gal. of petrol a year, advanced production in the first five months of 1958 to the annual equivalent of about 29,700,000 gal., from 19,700,000 gal. in 1957, 8,000,000 gal. in 1956, and 322,000 gal. in 1955.

Vierfontein Colliery, Ltd., which is operating a colliery in a coal area of 33,313 acres under lease in the north-western Free State and supplies one of the major power stations of the Electricity Supply Commission according to a formula variable with major changes in money values, expects that its output will be built up to and maintained at least at 1,560,000 tons a year from 1960. The estimated reserves in the lease area exceed 60,000,000 tons and are considered adequate for an annual output rate of 1,620,000 tons over a life of 40 years.

**Central African Federation.**—In order to achieve the fastest possible sinking rate Mufulira Copper Mines, Ltd., has engaged a

firm specializing in shaft-sinking to sink two new shafts into its west ore-body. This move is expected to advance production in the new section by 12 to 15 months.

**Tanganyika.**—Negotiations are in progress between the Tanganyika Government and De Beers Consolidated Mines on the one hand and the shareholders in Williamson Diamonds, Ltd., for the sale to the former of joint control or a substantial interest in the company. Sales of the company are conducted through the Diamond Producers Association in London. The transaction will have to be approved by the Tanganyika Government alone or with the Colonial Office of the United Kingdom Government, which is apparently being represented at the discussions being held in London. Agreement in principle has been reached among the parties concerned in the discussions, according to reports which have also stated that certain complications have still to be resolved. The company's production accounts for more than 90% of the Territory's diamond output of 357,538 carats, valued at £2,855,273, in 1956 and 372,738 carats, valued at £3,287,782, in 1957, and 172,046 carats, valued at £1,534,344, in the first five months of 1958. The transaction will involve many millions of pounds, one estimate being as much as £15,000,000 if an outright sale is negotiated.

**Uganda.**—A programme of capital expenditure for the expansion and further development of the phosphate-pyrophyllite deposits at Sukulu has been approved by the Government. Of the total of £7,000,000, £4,000,000 will be expended on the mining side and £3,000,000 on related railway development to facilitate exports of the output. The main product will be phosphate concentrates with niobium concentrates the by-product.

**South-West Africa.**—The S.A. Minerals Corporation, Ltd., over the first half of the year produced 59,477 long tons and shipped 52,289 tons of manganese ore from its South-West African deposits, the respective figures for the second quarter being 31,793 and 20,484 long tons; over the six months 3,829 long tons of chromite were produced and 6,877 shipped from the Western Transvaal deposits, the output in the second quarter being nil and shipments 998 long tons. Chromite production has been suspended and manganese ore output will be suspended in the very near future. In both cases this decision arose from weak conditions in the mineral markets.

## Rare Metals in Carbonatites

The widespread activity currently being shown in the exploration and development of carbonatite massifs as sources of niobium uranium, the rare earths, zirconium, phosphates, vermiculite, and other products has resulted in the simultaneous publication of French and Russian reports reviewing recent studies on this topic. These publications will interest the many economic geologists working in this field.

In *Sciences de la Terre*, vol. iv (1958 for 1956), pp. 105-151, Jules Agard has summarized the now extensive literature on the economic geology of these rocks, in a paper entitled "Les gîtes minéraux associés aux roches alcalines et aux carbonatites." With recent discoveries of carbonatite in Morocco, these peculiar formations which were not long ago regarded as rarities can now be recognized as pan-African.

A volume in Russian on "The Geology of Deposits of the Rare Elements: Part I.—Rare-metal Carbonatites" (*Gosgeoltekhnizdat*,

Moscow: 1958, 127 pp., 5r. 75k.), edited by A. I. Ginzburg, provides a useful condensation of the western literature (116 references) but is somewhat reticent about Russian activities (16 references). Within the U.S.S.R. rare-metal carbonatites are on record in the Kola peninsula (3 bodies), in the Eastern Sayan range, in the upper reaches of the River Aldan (2), and in the north-west part of the Siberian platform (2). Another complex near Zhdanov (Mariupol) in the Ukraine is noted by Agard but fails to be mentioned in the Soviet volume.

In the two works together there are recorded at least 25 instances where carbonatite "intrusions" have been explored as a source of rare-metal ore—three of these in Canada, one in U.S.A., one in Brazil, six in Europe including Kola, at least three in Asia, and the remainder in Africa. Perhaps the most conspicuously successful developments have been those in the Kola peninsula where the reported resources of apatite, niobium, and zirconium far exceed anything known elsewhere.

C. F. D.

## Trade

## Notes

Brief description of a  
development of  
interest to the  
mining engineer

### Rubber-Lined Tanks for Rand Uranium Plants

In the design of plants for the acid extraction of uranium from Witwatersrand mines various anti-acid protective linings were tried by the Uranium Technical Subcommittee of the Transvaal and Orange Free State Chamber of Mines, including the possible use of wood, acid-resisting brick, glass, sprayed compounds, and stainless steel. After investigating the various methods used in Canada and America on chemical resisting mediums it was finally considered that rubber-lined mild-steel tanks and pipe-work

would be the most suitable type of equipment for use in South Africa. The **Dunlop Rubber Co., Ltd.**, which had been conducting experiments in rubber-lining processes and techniques in conjunction with the Chamber of Mines, was finally commissioned to provide linings for four of the uranium plants then contemplated, the initial task comprising the lining of 750,000 sq. ft. of tank surfaces with acid-resisting rubber. Similarly 100,000 ft. of piping, over 1,000 pump-agitator units, and miscellaneous equipment on mine sites as far away as 132 miles from the Dunlop factory at Benoni had also to be treated. Some of the tanks were 45 ft. high

**Rubber-Lined  
Tanks at  
Hartebeestfontein.**



and 22½ ft. in diameter, others 12 ft. high and 50 ft. in diameter.

Effective sandblasting of the surfaces to be rubber lined and fume extraction from the great tanks during lining and the bonding of rubber lining to the interior surfaces of pipes and valves involved the use of compressed-air equipment and **Atlas Copco** portable compressors were used at the mine sites and extensively at the Benoni plant. After sandblasting and during lining the tanks were protected from rain and dust by heavy sectional canvas roof covers.

Apart from sandblasting, compressed air was used extensively, it is stated, in effecting efficient bonding of rubber lining to the inside surfaces of pipes by means of an ingenious pneumatic expander specially developed for the work. This consisted of a horizontally-operated rubber bellows fitted to the end of a long metal compressed-air tube, which, after insertion into the previously-treated piping, achieved maximum bonding of rubber liners and adhesives to the interior pipe surfaces by means of compression expansion. The process also expelled all air between the metal and rubber liners. In the final vulcanizing process compressed air acted as a coolant after the steam treatment.

Emerging through difficulties and problems of the technical unknown the first four South African uranium extraction plants were successfully completed on schedule by October, 1952. From 1951 onward the Dunlop Company in South Africa has

processed over 60 acres of rubber lining, involving the use of 1,600 tons of rubber, on 13 uranium extraction plants on the Transvaal and Orange Free State goldfields. This is an achievement considered to be the greatest rubber-lining undertaking accomplished anywhere in the world.

At the Dunlop factory at Benoni compressed air, it is stated, has played a major rôle in the rubber lining of tens of thousands of feet of piping, as well as numerous separate small items of equipment for the uranium plants. When operations first started Dunlop was using two Atlas compressors—an AR3 and an AR4; a second AR3 has since been installed. Based on the experience gained in the uranium project compressed air operated equipment at Benoni is making further valuable contributions to the efficiency of various rubber manufacturing processes; it is used primarily for the operation of pneumatic tools where the danger of fire makes electrically-driven tools a hazard.

### **Ruston Air-Cooled Diesel**

An expansion in the range of air-cooled diesel engines has recently been effected by **Ruston and Hornsby, Ltd.**, of Lincoln, with the addition of the class YWA and the class YDA, each of which are the subject of fully-illustrated booklets. The YWA is a



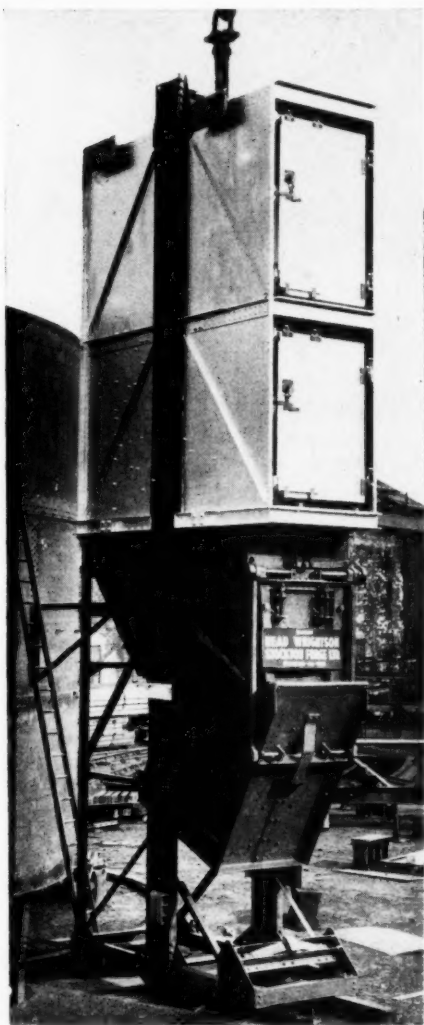
4-cycle air-cooled engine of 4 in. bore by 4½ in. stroke, manufactured in 1 and 2 cylinder sizes providing a power range from 6 to 24½ b.h.p. at an automotive rating over a speed range of 1,000 to 2,200 r.p.m., the British Standard rating being 6 to 19 b.h.p. at 1,000 to 1,800 r.p.m. The YDA is a 4-cycle unit of 4¾ in. bore by 5 in. stroke, manufactured in 2, 3, 4, and 6 cylinder sizes, providing a power range from 16 to 110 b.h.p. at an automotive rating over a speed range from 1,000 to 2,200 r.p.m., the British Standard rating being 16 to 87 b.h.p. at 1,000 to 1,800 r.p.m. The introduction of these new engines enables the company to offer air-cooled diesels covering power requirements from 4 to 110 b.h.p. at speeds up to 2,200 r.p.m.

### Composite Metal Skips

Illustrated here is a composite steel-aluminium alloy ore-carrying skip designed and manufactured by **Head Wrightson Stockton Forge, Ltd.**, a subsidiary of **Head Wrightson and Co., Ltd.**, for the Ashanti Goldfields Corporation, Ltd. Head Wrightson was asked to supply three such skips, each with a capacity of 12,000 lb. of ore. The skips are partly mild steel and partly aluminium alloy, specially designed so that existing winding equipment at the mines could be utilized. An all-steel skip, it is stated, would weigh 1½ tons more than the steel-aluminium alloy type supplied, each of which weighs 7 tons 13 cwt. The skips are

fitted with rails on the lower deck to accommodate a mine locomotive or materials car and they can be adapted to carry men. A trap door in the lower deck of the skip is inverted to form a chute into the ore hopper during loading.

The height of the skips is 30 ft., the width 4 ft. 5¼ in., depth 11 ft. 4 in., and the height between decks 6 ft. 6 in. Using aluminium to specification H.30 W.P., ⅝-in. diameter aluminium rivets were driven during construction.



### Prosper Core-Drill.



### Prospecting Core Drill

Details of a new light portable drill which can quickly be dismantled into individual loads for easy transport have been released by the **Craelius Co., Ltd.**, of 11, Clarges Street, London, W. 1. Known as the "Prosper" it gives a  $\frac{3}{8}$ -in. core to 100 ft. depth and incorporates the Swedish company's patented feed and variable speed control. The outstanding features claimed for the drill, which is illustrated here, are that its construction is totally enclosed and moisture-proof and dust-proof, while all shafts run on antifriction bearings. The bit speed can be varied from 0 r.p.m. to 900 r.p.m. this being controlled, as can the feed rate, by hand-wheel, the desired bit pressure being automatically maintained irrespective of any change in formation hardness; a direct-reading gauge indicates the actual bit pressure. Rapid spindle retraction is obtained by push-button control. The drill can be fitted with petrol engine, electric motor, or air motor and is quickly dismantled into four components, of which the heaviest (the engine) weighs 68 lb. Spindle head and engine are carried on the back in specially made rucksacks. Available for use with the

drill are the company's Flush Pump Type SP 55 x 20 and complete operating equipment. The flush pump, with its frame, weighs 53 lb., while the petrol engine for it weighs 26  $\frac{1}{2}$  lb.

### Precession Magnetometer

The Varian nuclear precession magnetometer, an instrument used in the Vanguard earth satellite and Aerobee rocket programmes of the United States, has been introduced into Canada by **Spartan Air Services, Ltd.**, Ottawa, it is announced, as an airborne prospecting tool for oil and mining exploration. The Varian unit in its new form will record its results on punched tape instead of continuous strip chart. The tape is then fed into an "electronic brain" digital computer on the ground to give the results quickly. When mapped the computer results indicate the presence of ferrous-type minerals—such as, iron, nickel, and titanium—the presence of basement topography and thickness of overlying sedimentary section for oil exploration, and general information on structural geology.

Spartan Air Services is equipping some

of its helicopters and other aircraft with the new nuclear magnetometer for work in eastern and western Canada as well as abroad in South America and Africa.

The nuclear magnetometer is an ingeniously simple device whose "brain" or sensing element is essentially a coil of wire immersed in a bottle of water or other liquid containing hydrogen atoms. It uses the principle of nuclear induction—that is, the hydrogen atoms are made to oscillate under the influence of the earth's magnetic field, the frequency of the oscillation being proportional to the earth's magnetic field at any point. This

frequency is then recorded on punched tape for convenient computer processing. It is claimed that the magnetometer has a number of advantages over older magnetometers since: (a) Measurements are based on an unchangeable property of the hydrogen proton and hence are not affected by changes in temperature, humidity, pressure, or by mechanical shocks; (b) the instrument is calibrated on a constant of nature and not by a laboratory system, and (c) measurements are independent of orientation of the instrument with respect to the earth's magnetic field.

## Personal

A. T. AHLSTON is returning from Greece.

B. BARTLETT is returning from Ghana.

W. M. BOX is home from Ghana.

G. J. BROWN has retired from the Nordberg Manufacturing Co., having until recently been manager overseas since 1929.

G. L. BROWN-DOUGLAS is home from Burma.

A. R. CATOR, manager of the Ellaton mine, has been appointed manager of South Roodepoort Main Reef Areas in succession to H. J. G. C. ARNDT, who has retired.

A. J. CHUTER is here from Northern Rhodesia.

F. H. FITCH is home from Borneo.

V. L. GASPER is now at the head office of the Cementation Co., Ltd., in Doncaster.

G. S. GILES has been appointed general manager for Nchanga Consolidated Copper Mines, Ltd., in succession to L. W. ALLEN who died on July 17.

D. W. HANNAFORD is home from Burma.

E. G. HARVEY has left for Sierra Leone.

B. W. HOLMAN is here from Pakistan.

L. R. JACKSON is here from Canada.

E. H. JACQUES is home from Ghana.

R. H. KERR has left the Belgian Congo for Switzerland.

W. L. G. MUIR is leaving for Sierra Leone.

R. NEELANDS is visiting Canada.

D. G. NORRIS has left for Mexico.

J. E. PHILPOTT has left for Ghana.

W. S. RAPSON has been appointed an additional vice-president of the South African Council for Scientific and Industrial Research.

G. W. H. RELLY has been appointed a manager in Johannesburg of the Anglo American Corporation of South Africa.

J. E. ROBSON has left for Ghana.

E. D. SHEARN has been elected chairman of the Council of the Malayan Chamber of Mines and J. N. DAVIES vice-chairman.

R. SLATER is now in Canada.

J. SUTTON, Reader in Geology at the Imperial College of Science and Technology, has been appointed to the university Chair of Geology tenable at that college.

K. THOMPSON has left for Cyprus.

E. R. TONKYN is home from Malaya.

W. J. DE VILLIERS has been appointed manager of Rhokana Corporation, Ltd., in succession to G. S. GILES.

N. W. WILSON has left for Sierra Leone.

## INSTITUTION OF MINING AND METALLURGY

### Elections and Transfers

*Member.*—Arthur Edward BAXTER, B.Sc. (Bristol); John Keith Elers DOUGLAS, M.Sc. (Johannesburg).

*Associate Member to Member.*—James Charles BOLSOVER, A.C.S.M. (Nsuta, Ghana); James CAMERON, D.Sc. (Senhorim, Portugal); John J. COLLINS (London); Ralph DANIEL, A.R.S.M. (Johannesburg); Alexander Nicol NAPIER, A.H.-W.C. (Kirkcaldy); Francis Henderson WAY, A.C.S.M. (Sungei Lembing, Malaya).

*Associate Member.*—Cecil Basil CURTIS, A.C.S.M. (Peru); Jack DAVISON, B.Sc. (Carletonville, Transvaal); Peter DYSON, B.Sc. (Ventnor); Donald Frederick George HAMPTON (West Wickham); John Marcel Raymond HORA (London); Robert Gibson HORNE, B.Sc. (Dodoma); Dougal John McPHERSON, B.Sc. (Bristol); Leonard Richard MABSON, A.C.S.M. (Delabole); Stephen William MOREL, B.Sc. (Nicosia); Trevor Hilton PARK, A.C.S.M. (Cardiff); John Alan TOWNSEND, B.Sc. (Mufulira); John William WHITE (Wetherby); Wallace John WILLIAMSON (Perranporth).

*Student to Associate Member.*—Arthur John CAVE, A.C.S.M. (Singhbum); Piers Maurice EBSWORTH, A.R.S.M. (Renabie, Ontario); Edward Garfield HARVEY, A.C.S.M. (Hangha, Sierra Leone); Bryan Harold PILE, A.R.S.M., B.Sc. (Didcot); Alastair Thomas TRIGGS, A.C.S.M. (Kalalushi).

*Affiliate.*—Peter Crichton WINDEBANK (Sidcup).

*Student.*—Konstantin BABICH (Johannesburg); Graham Francis BOND (Queensland); Buchi Bangara Raju CHINTALAPATI, B.Sc. (Camborne); Padmabh CHAUDHARY, A.I.S.M., B.Sc. (Dhanbad); Geoffrey Alan DUNLOP (Queensland); John Derrick EDEN (Camborne); Gordon Marcus FREEMAN (Camborne); James Henry GLEW, B.Sc. (Leeds); Alexander Wallace GOURLAY (Camborne); John David PARKER (Kitwe); George Vivian SANDERCOCK (Camborne); John Roger TUFFLEY (Queensland); Brian Kenneth WELCH, A.C.S.M. (Durham); Chong Syn YEN, A.C.S.M. (Malim Nawar, Malaya); George Herbert ESPLEY, B.Sc. (Yellowknife).

## Metal Markets

### During July<sup>1</sup>

**Copper.**—Copper prices have continued to recover from their low point in July and now seem reasonably comfortably established at over the £200 per ton mark.<sup>2</sup> There has been no lack of specific developments of a bullish nature in the month and it would be quite possible to argue that these alone have been responsible for the overall improvement in the market during the month. However, the view is gaining ground increasingly that the fundamental copper position is not so depressing as it has been and that while a dynamic recovery can hardly be hoped for it does look as though the rot may have been more or less halted. A cogent example of the facts that underlie this shift in sentiment is the American copper statistics for June; these were the most encouraging for a considerable time, showing both an increase in output and a decrease in stocks.

Of the specific developments affecting the market the most widely familiar will be the Iraqi *coup d'état* which precipitated a general state of ferment in the Middle East. From the point of view of the copper market, however, this was not the most significant event, since after only a few days' excitement on the strength of the turmoil the market quickly became more apathetic to developments in the Middle East at the same time that affairs were themselves became less dramatic.

Of more direct interest to the market has been the progress which has been made in U.S. legislative circles of the proposals to support the mining industry there, particularly as far as the proposal to stockpile 150,000 short tons of copper at up to 27½ cents per lb. is concerned. Somewhat to some people's surprise this progress has been remarkably good; the copper stockpiling programme, a fairly straightforward and (by American Government standards) inexpensive proposal, has had a fair measure of support all along. The proposals concerning lead and zinc, with which it appears in the same Bill, have, however, been less enthusiastically received by economy-minded members of the House of Representatives. Notwithstanding this the Bill as a whole has only to pass the full committee of the House of Representatives before being sent to the President.

Of longer-term interest has been the news that "COCOM", the Committee dealing with East-West trade, has secured agreement on the whittling down of the list of items on which there is an embargo or restriction on exports to Communist countries. Copper (as distinct from copper wire) is understood to have been removed from the list, although official confirmation of this will not be forthcoming until mid-August. Meanwhile the regular business in copper wire to Russia from the U.K. continues.

Consumption of copper in the U.K. in May was 43,571 tons refined and 10,662 tons in scrap. Production was 18,825 tons primary refined and 8,335 tons secondary refined, while stocks moved little in total, refined stocks dipping to 67,355 tons and blister advancing to 21,558 tons.

**Tin.**—The main event in the tin market in the past month was the meeting of the International Tin Council on July 22. At this meeting it was

decided to intensify the austerity regime which the Agreement has pursued since December 15 last. Export for the fourth control period (which coincides with the fourth quarter of the calendar year) has been fixed at 20,000 tons, against 23,000 tons in the third period. This will represent a cut in exports compared with September last year of 48%, or very nearly half. Notwithstanding this stern move prices on the Metal Exchange<sup>1</sup> are still, at the time of writing, at the support minimum and the contango is little better than it was a month ago. It is true that prices have been better during the month, but this was as much on Middle East considerations as anything. Proposals to invite Russia and other non-participants to join the Tin Agreement have been followed up by the Council, but a cynical view is held of the replies that will be forthcoming.

Consumption of tin in the U.K. in May was 1,583 tons, whilst production shot up to 3,400 tons. End-month stocks were a little up at 21,529 tons.

**Lead.**—As was mentioned in dealing with copper the Bill providing for support for U.S. lead mines has made rather better progress than some people expected. It is true that the Bill has not yet been passed by the full House of Representatives, but the fact that it has got as far as being considered thus far before the end of the current session, and in as close a shape to that in which it was first introduced, is an encouraging augury for the proposals' being finally passed into law. At present this development would mean that U.S. producers might expect to receive subsidies on up to 350,000 tons of lead, making up the difference between their actual sale price and a price of 15½ cents, subject to a maximum subsidy of 3.9 cents. Pending clarification of this the market is mainly under holiday influences.<sup>1</sup>

Lead consumption in the U.K. in May was 28,839 tons, so that the total for the first five months of the year is 5,000 tons less than in the comparable period of 1957. Production was 7,202 tons primary metal and stocks were 37,608 tons.

**Zinc.**—Zinc prices<sup>1</sup> are, of course, dependent on the same political considerations in the American field as lead. For the record it should be noted that after a bewildering number of variations the support proposals now call for stabilization payments, not exceeding 2.9 cents per lb., so as to give the producers a return of 13½ cents on their sales of 550,000 tons of zinc. At times the maximum subsidy has stood at 4 cents and this has obviously been a point of interest for non-U.S. markets, as it would obviously determine the level at which imported material would have to compete with domestic production. Assuming 2.9 cents goes through the effective U.S. floor price would be 10.6 cents per lb., which is not very different from current levels and is unlikely to affect London much.

U.K. May consumption was 24,579 tons, production 5,698 tons, and stocks ended the month at 50,539 tons.

**Iron and Steel.**—In June U.K. exports of iron and steel fell sharply to 182,568 tons from 255,037 tons in May, but the London dock strike may well have been partly the cause for the seriousness of the decline. In the first five months of the year, although U.K. exports have fallen substantially, figures published by the Iron and Steel Board show that this country has maintained her share of world trade in a declining

<sup>1</sup> Recent prices, pp. 72, 112.

<sup>2</sup> See Table, p. 112.

<sup>1</sup> See Table, p. 112.

international market. Meanwhile various measures have been taken in order to give steelmakers the greatest possible scope in export markets. Heavy-steel export prices have now been reduced to more or less the level of home prices and export licensing has now been abolished for semi-finished steel.

Imports, of course, have fallen to a low level and at present comprise mainly pig-iron, ferro-alloys, semis, and sheets. The pig-iron and semis arrivals are rapidly declining, however, as outstanding contracts are completed and ferro-alloy imports are also being cut down. Soon the chief item of imports will be sheet steel, demands for which from the booming motor-car industry are apparently insatiable. In the first six months of this year total iron and steel imports were 484,642 tons, against 661,863 tons in the corresponding period of 1957.

The outlook for steel is not exactly bright. True the Government has taken various steps to stimulate steel consumption, but it will be some time before these will be translated into better buying. Meanwhile the world slump in shipping is casting a deepening shadow over shipyards here and plate makers, who so far have been kept busy, are becoming anxious about the future.

**Iron Ore.**—In the first six months of this year U.K. imports of iron ore totalled 7,054,113 tons, against 6,783,210 tons in the same six months of 1957. Home output is declining.

**Aluminium.**—The month of July was in the main one of conjecture for the aluminium market. The main question was would there be a price rise in the United States at the beginning of August? The major companies have been saying for some time past that they do not think it possible to avoid passing on to consumers the increase in labour costs which will arise from the automatic wage increase to their employees on August 1. However, the American producers were concerned about the possible attitude of the Canadians to any price movement. The increase of 0.7 cents per lb. announced by Alcoa must be intended to be a compromise. The Canadians, with their policy of moving their prices up on a world basis, are nevertheless not likely to make any such move at the present time, particularly with supplies of cheap Iron-Curtain material fairly readily available in Europe. Therefore, unless the Canadians break away from their traditional system, the rise in the U.S. domestic price will leave the Canadian selling price in the U.S.A. at a lower level, with rather obvious results. Even if the anti-dumping duty application in the U.K. (applied for early this year) were granted, thereby making a Canadian price increase a possibility, it is doubtful that any increase would be made at this time, particularly as the duty would not of course affect Europe generally.

No doubt, following the American price rise, U.S. producers would like to see the Canadians break away from tradition and increase their price in the U.S.A. while retaining the present price elsewhere.

Aluminium, Ltd., announced at the end of July, that as from August 1 output was to be cut by 10%. This will bring the annual rate down to 560,000 tons.

Aluminium ingots in the United Kingdom are still quoted at £180 delivered, while material from sources other than Canada is quoted at around £161 to £165 nom.

**Antimony.**—During July consumer buying in-

terest in antimony was not particularly strong, while supplies were, and still are, fairly plentiful. These remarks apply in the main to imported material and in the case of U.K. regulus the increased import duty has had the effect of increasing interest on the part of consumers to some extent, particularly as English material has the added advantage of quicker delivery. It seems, in fact, that if the Chinese and Russian antimony is to regain its former position in this market quotations will once again have to be reduced.

English regulus is quoted at £197 10s. per ton delivered.

**Arsenic.**—So far this year the face of this market has remained unchanged and there are no signs of any disrupting influences coming forward in the near future. Trioxide imports into the United Kingdom are still at a fairly low level, on a monthly basis that is, although comparing the first six months of this year (2,182 tons) with the same period of 1957 (2,568 tons) the difference is quite small. The price of trioxide is still quoted at £40 to £45 a ton.

**Bismuth.**—This market seems to get more uninteresting every month. Imports into the United Kingdom during the year have decreased month by month and during June totalled 33,292 lb., as compared with over twice this amount in the previous month. Total imports during the first half of the year amounted to 484,452 lb. The U.K. price is unchanged at 16s. per lb.

**Cobalt.**—July, the real beginning of the holiday months, has seen little change in this market and very much the same position obtains as in the past three of four months.

Imports during June totalled only 6,799 lb., as compared with 128,657 lb. in May. The half year total is 721,839 lb., against 1,455,958 lb. in the first six months of 1957. The U.K. price is still quoted at 16s. per lb.

**Cadmium.**—There were no outstanding developments in this market during July and as mentioned in the report for June there do not appear to be any signs of change in the near future. The price of both U.K. and Empire metal and of foreign metal is still quoted at 10s. per lb.

**Chromium.**—This market still continues to jog along in its own particular fashion with no changes to record. Chromium metal is quoted at 6s. 11d. to 7s. 4d. per lb.

**Tantalum.**—Imports of tantalite-columbite ores into the United Kingdom continue at a comparatively low level, during June totalling 17 tons as compared with 19 tons in May. During July the price of tantalite was reduced and is now quoted at 900s. to 950s. per unit. The comparatively small number of consumers of this ore seem to be fairly well covered for some time and have been holding off the market, thereby bringing about the fall in price.

**Platinum.**—Towards the end of July the price of U.K. and Empire-produced platinum took another fall and is now quoted by both leading sellers at £23 5s. per troy oz. As is usual with reductions in this price it was not unexpected, as the open-market price has been considerably lower for some time. This latest reduction was paralleled in the United States, where leading refiners are now quoting \$62 to \$65 per troy oz. Open-market prices in the U.K. and U.S.A. are now £20 to £21 and \$58 to \$62 per troy oz., respectively.

**Iridium.**—This market remained quiet during

July and there are no signs of any alteration in the situation in the near future. The U.K. price is £20 to £23 per troy oz.

**Osmium.**—Osmium remains dull and uninteresting with very little consumer demand apparent. As was mentioned in the report for June, the price has fallen to £18 per troy oz.

**Palladium.**—There have been no new developments in this market since the last review of the position and the price remains at £5 to £5 15s. per troy oz.

Imports of platinum-group metals during June totalled 6,283 oz., a further fall from the previous month and a considerable drop from the imports in June, 1957, which totalled 27,790 oz.

**Tellurium.**—Once again this metal has continued its uninspired passage through the month, with no change to report. It is still quoted at 15s. to 16s. per lb.

**Tungsten.**—With stocks in consumers' hands at a low ebb a certain amount of buying occurred in July, stimulated by the Middle East situation, and this helped to lift tungsten for a very short time out of the doldrums. However, although the price which the ore reached—62s. 6d. to 67s. 6d. per unit—has been held, now that most consumers have restocked there is a tendency for apathetic conditions to return.

**Nickel.**—During July the most interesting occurrence in this market was undoubtedly the cut in Inco's scale of operations. This is the third cut made by the Canadian company and effective from July 14 operations were reduced to an annual rate of production of 100,000 tons of nickel. The reason for the cut is, as before, the accumulations of stocks in the hands of producers and of the U.S. Government outside the stockpile. Despite this

cutback Inco is still going ahead with its Manitoba project.

The price of nickel in the U.K. quoted by the leading seller is still £600 a ton despite the reduction in the open-market price last month.

**Chromium.**—Not until the end of the month was any interesting news forthcoming from this market. On July 31 a price decrease, consequent on a reduction in freight rates, was announced. Whether or not this latest reduction will assist materially in reducing stocks remains to be seen.

Rhodesian metallurgical grade ore 48% is now quoted at £15 15s. per ton.

**Molybdenum.**—In the second half of the month of July a strike broke out at the Climax, Colorado, mine of American Metal Climax Inc. and operations at the mine are completely stopped. However, this stoppage is most unlikely to affect supplies for many months, as the company has substantial stocks of material. In fact it was these heavy stocks which in part decided the company to cut back operations in March this year.

The price in the U.K. remains unchanged at 8s. 5d. per lb. of metal contained.

**Manganese.**—There has been absolutely no improvement in the manganese situation during the past month. Indeed the Indian Government has made the producers' position further untenable by enforcing the Mines and Minerals Act, which increased as from June 1 the rate of royalties paid by the mines from 7½% to 12½% of the f.o.b. mine value of ore mined. Industry spokesmen have asked the Government not only to reconsider imposing the new rate, but to reduce the rate to the 5% originally fixed in 1949.

At present 46% to 48% manganese ore is currently quoted at 84d. to 88d. per unit of metal contained.

### Tin, Copper, Lead, and Zinc Markets

Tin, minimum 99.75%; Copper, electro; Lead, minimum 99.75%; and Zinc, minimum 98% per ton.

Date		Tin		Copper		Lead		Zinc	
		Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
July	10	£ 730 10	£ 731 5	£ 196 0	£ 196 7½	£ 71 8½	£ 73 3½	£ 63 8½	£ 63 18½
	11	730 10	730 15	195 2½	195 17½	70 2½	72 2½	62 8½	63 3½
	14	731 0	731 5	198 0	198 17½	69 8½	71 12½	62 1½	63 2½
	15	731 0	732 5	198 12½	199 12½	69 8½	72 1½	62 12½	64 2½
	16	731 0	733 15	200 12½	201 7½	72 2½	73 3½	65 10	65 17½
	17	735 10	738 5	204 15	205 7½	73 2½	74 7½	65 7½	65 17½
	18	734 0	733 15	202 5	203 5	71 7½	72 17½	64 0	64 12½
	21	731 0	733 5	202 0	202 15	70 17½	72 8½	63 15	64 8½
	22	732 0	734 15	204 7½	205 2½	72 0	73 7½	64 7½	65 2½
	23	731 10	734 5	203 12½	204 2½	71 7½	72 18½	63 16½	64 11½
	24	732 10	735 5	203 15	204 10	71 10	72 17½	63 10	64 7½
	25	735 0	739 10	203 2½	203 12½	71 12½	72 18½	63 11½	64 11½
	28	732 0	735 5	203 2½	203 12½	70 12½	72 7½	63 12½	64 8½
	29	731 0	734 10	205 7½	205 12½	71 2½	72 12½	64 2½	64 13½
Aug.	30	731 0	734 5	205 17½	205 17½	71 8½	72 13½	64 3½	64 16½
	31	730 10	733 5	207 7½	207 7½	71 17½	72 18½	64 15	65 6½
	1	731 10	733 10	209 17½	210 2½	72 1½	73 2½	64 17½	65 7½
	4	—	—	—	—	—	—	—	—
	5	731 0	734 15	209 15	210 2½	72 16½	73 17½	64 17½	65 12½
	6	731 10	736 15	208 7½	208 12½	72 16½	73 12½	64 12½	65 6½
	7	731 0	734 5	203 7½	203 17½	72 6½	73 1½	64 7½	65 2½
8	731 0	734 5	207 7½	207 12½	72 1½	73 2½	64 15	65 6½	
11	730 10	733 10	207 15	208 2½	71 6½	72 12½	64 7½	65 2½	

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Brakp  
Buffel  
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Crown  
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Doorn  
D'rb'n  
East C  
East L  
East C  
East L  
Easter  
Ellato  
Freddi  
Free S  
Gedul  
Govern  
Groov  
Harmo  
Hartel  
Libano  
Lorain  
Luipa  
Mariev  
Merrie  
Modde  
New K  
New F  
Presid  
Rand  
Randf  
Rietfo  
Robin  
Rose J  
St. He  
Simme  
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## Statistics

## TRANSVAAL AND O.F.S. GOLD OUTPUTS

	JUNE		JULY	
	Treated Tons.	Yield Oz.*	Treated Tons.	Yield Oz.†
Blyvooruitzicht .....	101,000	62,069	106,000	66,967
Brakpan .....	126,000	16,176	129,000	16,504
Buffelsfontein† .....	117,000	39,145	117,000	39,172
City Deep .....	108,000	22,026	115,000	23,805
Cons. Main Reef .....	140,000	20,600	136,000	21,087
Crown Mines .....	225,000	33,966	240,000	36,145
Daggafontein† .....	242,000	49,843	242,000	49,726
Doonfontein† .....	88,000	36,766	88,000	36,753
D'r'n Rooiepoort Deep .....	182,000	32,805	188,000	34,033
East Champ D'Or† .....	12,500	337	13,500	292
East Daggafontein .....	92,000	15,277	94,000	15,493
East Geduld .....	125,000	38,448	136,000	41,818
East Rand P.M. ....	222,000	56,209	242,000	59,357
Eastern Transvaal Consol .....	18,600	6,603	18,600	6,408
Ellatort .....	33,000	7,684	32,000	7,400
Freddies Consol. ....	56,000	14,529	58,000	14,063
Free State Geduld .....	69,000	49,433	70,000	50,200
Geduld .....	73,000	12,240	78,000	13,071
Government G.M. Areas† .....	61,000	11,400	63,000	11,430
Grootvlei Proprietary .....	195,000	41,558	205,000	43,577
Harmony Gold Mining .....	78,000	30,501	85,000	32,716
Hartebeestfontein† .....	87,000	47,415	87,000	47,415
Libanon .....	98,000	22,791	98,000	22,831
Lorraine .....	74,000	13,788	74,000	14,182
Luppaards Vleis† .....	120,000	14,023	121,000	13,769
Marievale Consolidated .....	69,000	18,117	74,000	19,347
Merriespruit† .....	—	—	—	—
Modderfontein East .....	136,000	12,907	146,000	13,761
New Kleinfontein .....	84,000	10,227	87,000	10,354
New Klerksdorp† .....	10,100	1,057	10,500	1,088
President Brand .....	90,500	67,882	96,000	70,779
President Steyn .....	99,000	37,609	100,000	37,831
Rand Leases .....	177,000	25,665	174,000	25,578
Randfontein† .....	193,000	14,983	207,000	14,903
Rietfontein Consolidated .....	21,500	4,957	21,500	4,902
Robinson Deep .....	70,000	14,031	72,000	15,851
Rose Deep .....	57,000	7,047	60,000	7,176
St. Helena Gold Mines .....	118,000	34,344	124,000	36,311
Simmer and Jack .....	90,500	16,958	90,000	16,853
S. African Land and Ex. .....	92,500	18,805	91,500	18,853
S. Rooiepoort M.R. ....	28,000	6,080	31,000	7,322
Sparwater Gold .....	10,700	3,296	10,700	3,298
Springs .....	128,000	14,204	129,000	14,661
Stifffontein Gold Mining† .....	113,000	55,805	117,000	57,310
Sub Nigel .....	66,500	15,910	66,500	15,963
Transvaal G.M. Estates .....	14,300	2,102	—	—
Vaal Reef† .....	74,000	33,303	76,000	34,507
Van Dyk Consolidated .....	75,000	14,041	80,000	14,997
Venterspost Gold .....	89,000	21,102	128,000	31,821
Village Main Reef .....	30,000	4,692	28,000	4,663
Virginia O.F.S.† .....	101,000	26,664	105,000	27,195
Vlakfontein .....	50,000	17,739	50,000	17,633
Vogelstruisbult† .....	96,000	21,252	95,000	21,333
Welkom Gold Mining .....	90,000	26,788	91,500	27,082
West Driefontein† .....	78,500	75,241	80,000	76,010
West Rand Consol.† .....	206,000	21,623	210,000	21,612
Western Holdings .....	100,000	55,950	100,000	56,004
Western Reefs .....	114,500	26,793	114,500	26,794
Witwatersrand Nigel .....	17,700	4,342	18,200	4,423

† 248s. 4d. \* 249s. 0d. ‡ Gold and Uranium.

## COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton		Total working profit
			s. d.	£	
June* 1957 .....	16,785,200	62 4	45 1	17 3	22,565,371
July .....	—	—	—	—	—
August .....	—	—	—	—	—
Sept.* .....	16,689,900	64 0	45 6	17 3	24,193,575
Oct. ....	—	—	—	—	—
Nov. ....	—	—	—	—	—
Dec. ....	16,198,500	64 4	46 1	18 3	23,605,380
Jan., 1958 .....	—	—	—	—	—
Feb. ....	—	—	—	—	—
Mar. ....	15,806,300	64 10	46 6	18 4	23,170,987
April .....	—	—	—	—	—
May .....	—	—	—	—	—
June .....	—	—	—	—	24,358,945

\* 3 Months.

## PRODUCTION OF GOLD IN SOUTH AFRICA

	RAND AND O.F.S.	OUTSIDE	TOTAL
	Oz.	Oz.	Oz.
July, 1957 .....	1,395,064	53,099	1,479,439
August .....	1,426,340	38,941	1,459,794
September .....	1,400,745	37,611	1,438,356
October .....	1,416,211	39,996	1,456,207
November .....	1,386,047	36,470	1,422,517
December .....	1,366,354	35,789	1,402,143
January, 1958 .....	1,377,505	40,534	1,418,039
February .....	1,322,843	33,879	1,356,722
March .....	1,394,566	36,330	1,431,286
April .....	1,401,084	38,352	1,439,446
May .....	1,435,960	36,404	1,472,454
June .....	1,408,384	39,187	1,447,571

## NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	GOLD MINES	COAL MINES	TOTAL
October 31, 1957 .....	310,428	28,020	338,448
November 30 .....	305,104	27,619	332,723
December 31 .....	299,137	27,623	326,760
January 31, 1958 .....	314,239	28,489	342,728
February 28 .....	326,885	30,227	357,112
March 31 .....	333,802	31,203	365,065
April 30 .....	337,284	31,424	368,708
May 31 .....	337,464	31,500	368,973
June 30 .....	334,882	31,336	366,218

## MISCELLANEOUS METAL OUTPUTS

	4-Week Period		
	To June 28		
	Tons Ore	Lead Concns. tons	Zinc Concns. tons
Broken Hill South .....	34,520	5,464	6,294
Electrolytic Zinc .....	17,583	873	5,530
Lake George .....	18,300	1,472	2,806
Mount Isa Mines** .....	80,599	4,500†	2,410
New Broken Hill .....	36,840	5,247	8,770
North Broken Hill .....	36,900	7,300	7,191
Zinc Corp. ....	54,000	6,478	9,590
Rhodesia Broken Hill* .....	—	—	—

\* 3 Mths. \*\* Copper 3,250 tons. † Metal.

## RHODESIAN GOLD OUTPUTS

	JUNE		JULY	
	Tons	Oz.	Tons	Oz.
Cam and Motor .....	30,545	9,749	30,907	9,642
Falcon Mines .....	22,300	4,300	22,610	4,346
Globe and Phoenix .....	6,000	3,598	—	—
Motapa Gold Mining .....	15,200	1,711	—	—
Nazoe .....	2,968	814	2,844	851
Coronation Syndicate .....	11,081	2,162	11,263	4,117
Phoenix Prince* .....	35,770	3,356	—	—

\* 3 Months

## WEST AFRICAN GOLD OUTPUTS

	JUNE		JULY	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket ....	59,091	13,923	60,171	14,285
Ariston Gold Mines .....	36,500	12,323	37,000	12,313
Ashtanti Goldfields .....	31,500	23,500	31,250	24,750
Bibiani .....	33,500	6,900	35,000	6,900
Brenang .....	—	5,533	—	4,462
Ghana Main Reef .....	11,157	4,296	11,194	4,098
Konongo .....	5,820	3,857	6,100	3,801
Lyndhurst .....	—	—	—	—

## PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1957		1958	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January .....	44,337	6,134	44,305	46,553
February .....	41,607	5,697	43,591	21,313
March .....	43,831	8,179	43,830	8,179
April .....	46,754	6,854	46,587	22,573
May .....	42,650	5,606	46,015	19,937
June .....	46,682	6,441	46,453	20,105
July .....	41,922	5,781	—	—
August .....	44,001	5,897	—	—
September .....	45,762	5,677	—	—
October .....	46,898	5,570	—	—
November .....	46,487	6,331	—	—
December .....	45,479	5,814	—	—

## WESTRALIAN GOLD PRODUCTION

	1956	1957	1958
	Oz.	Oz.	Oz.
January .....	96,388	106,722	96,562
February .....	94,638	64,949	65,965
March .....	66,944	67,121	65,420
April .....	90,415	66,435	60,855
May .....	62,294	64,886	64,196
June .....	63,570	65,142	—
July .....	69,883	74,420	—
August .....	72,903	75,727	—
September .....	62,204	64,422	—
October .....	64,594	64,524	—
November .....	64,113	65,700	—
December .....	65,031	66,562	—
Total .....	812,377	846,610	—

## AUSTRALIAN GOLD OUTPUTS

	4-WEEK PERIOD			
	To JUNE 9		To JULY 8	
	Tons	Oz.	Tons	Oz.
Central Norseman .....	—	—	14,002	8,363
Crossus Proprietary .....	—	—	—	—
Gold Mines of Kalgoolie .....	—	—	41,487	10,375
Golden Horse Shoe* .....	—	—	—	—
Gt. Boulder Gold Mines* .....	—	—	—	—
Gt. Western Consolidated .....	—	—	41,470	6,767
Hill 50 .....	—	—	—	—
Kalgurli Ore Treatment .....	—	—	—	—
Lake View and Star* .....	211,510	47,948	—	—
Moonlight Wiluna* .....	8,227	3,566	—	—
Morning Star (G.M.A.) .....	1,433	849	1,573	981
Mount Ida* .....	8,227	3,566	—	—
New Coolgardie .....	—	—	—	—
North Kalgurli .....	26,313	5,930	26,746	6,626
Sons of Gwalia .....	11,260	2,520	12,012	2,439
Mount Morgan .....	—	4,807	—	4,289

\* 3 Months.

## ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n \$
February, 1957 .....	702,636	197,225	32,199	6,635,527
March .....	793,674	215,830	35,787	7,250,018
April .....	771,608	216,457	35,085	7,314,450
May .....	790,159	222,496	37,241	7,509,698
June .....	738,384	207,897	32,544	6,945,127
July .....	718,468	198,630	30,620	6,572,323
August .....	701,174	192,453	31,647	6,410,429
September .....	722,384	205,471	34,248	6,947,813
October .....	772,383	224,217	37,086	7,657,426
November .....	756,494	219,352	37,737	7,441,702
December .....	750,537	215,462	44,230	7,494,280
January, 1958 .....	739,128	219,612	31,562	7,492,506
February .....	727,170	210,616	35,370	7,248,333
March .....	807,458	220,361	38,323	7,873,264
April .....	785,264	228,590	35,712	7,789,644
May .....	801,102	228,123	37,535	7,745,425

## MISCELLANEOUS GOLD AND SILVER OUTPUTS

	JUNE		JULY	
	Tons	Oz.	Tons	Oz.
British Guiana Cons. ....	—	1,503	—	—
Central Victoria Dredging ..	—	—	—	—
Clutha River .....	—	588	—	354
Emperor Mines (Fiji)* .....	180,188	74,931	—	—
Frontino Gold (Colombia) ..	—	—	—	—
Geita Gold (Tanganyika) ..	—	—	—	—
Harrietville (Aust.) .....	—	—	—	—
Lampa (Peru)* .....	—	36,660	—	31,820
Loloma (Fiji)* .....	—	—	—	—
New Guinea Goldfields .....	4,086	1,379	—	—
St. John d'el Rey (Brazil) ..	—	—	—	—
Yukon Consol. ....	—	\$318,000	—	—

\* 3 Months. † Ozs. Silver: 61 tons copper, 50 tons.

## OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	MAY	JUNE	JULY
Ampat Tin .....	76	—	79
Austral Amalgamated .....	—	141*	—
Batu Selangor .....	—	—	—
Berjuntai .....	120½	—	120
Chenderiang .....	—	20*	—
Gopeng Consolidated .....	—	106*	—
Hongkong Tin .....	—	49*	—
Idris Hydraulic .....	—	36*	—
Ipooh .....	—	48½*	—
Jelapang Tin .....	—	—	—
Kampung Lanjut .....	61	—	67
Kamunting .....	115	—	127
Kent (F.M.S.) .....	—	37*	—
Kepong .....	—	43*	—
Killinghall .....	—	53*	—
Kinta Kellars .....	—	—	35
Kinta Tin Mines .....	—	54½*	—
Klang River .....	—	—	—
Kramat .....	31	—	56
Kuala Kampar .....	103	—	113½
Kuala Lumpur .....	—	—	—
Kuchai .....	—	—	—
Lahat Mines .....	—	—	—
Larut .....	—	—	—
Lower Perak .....	136	—	125½
Malayan .....	—	286*	—
Malaysiam .....	4½	—	6
Pacific Tin Consolidated .....	—	415*	—
Pahang Consolidated .....	—	53*	—
Pengkalan .....	—	138*	—
Petaling Tin .....	—	89*	—
Puket .....	—	—	—
Rahman Hydraulic .....	—	—	—
Ranbunan .....	—	23½*	—
Rantau .....	40	—	31
Rawang Concessions .....	—	—	—
Rawang Tin Fields .....	—	—	—
Renong .....	—	116*	—
Selayang .....	—	46*	—
Siamese Tin Syndicate (Malaya) ..	—	8	31½
Southern Kinta .....	296	—	275½
Southern Malayan .....	—	454*	—
Southern Tronoh .....	—	163*	—
Sungei Besi .....	—	117½*	—
Sungei Kinta .....	—	38*	—
Sungei Way .....	—	194½*	—
Taipang Consolidated .....	37½	—	44
Tambah Consolidated .....	—	—	—
Tanjong .....	—	119*	—
Tekka .....	—	18*	—
Tekka-Taiping .....	—	—	—
Temoh .....	—	13*	—
Tongkah Compound .....	—	—	—
Tongkah Harbour .....	25	—	34
Tronoh .....	—	335*	—
Ulu Klang .....	—	—	—

\* 3 months.

## MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	JUNE		JULY	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	193	—	213	22
Anglo-Burma Tin .....	19	—	20	—
Bangor .....	15	—	72	—
Beral .....	54	80†	65	95†
Bisichi .....	34	3	40½	6
Ex-Lands Nigeria .....	42	—	51	—
Geevor .....	60	—	64	—
Gold and Base Metal .....	37	1	37	1
Jantar Nigeria .....	14	12	13	12½
Jos Tin .....	15	—	—	—
Kaduna Prospectors .....	8	—	5	—
Kaduna Syndicate .....	19	—	14½	—
Katu Tin .....	43	—	72	—
Keti Tin .....	—	—	—	—
London Nigerian Mines ..	—	—	—	—
Mawchi Mines .....	—	68‡	—	—
Naraguta Extended .....	12	—	—	—
Naraguta Karana .....	8	—	—	—
Naraguta Tin .....	—	—	—	—
Renong Consolidated .....	—	—	—	—
Ribon Valley (Nigeria) ..	4½	—	—	—
Siamese Tin Syndicate .....	8	—	33	—
South Bukuru .....	—	—	—	—
South Crofty .....	67	—	71	—
Tavoy Tin .....	—	—	—	—
Tin Fields of Nigeria .....	—	—	—	—
United Tin Areas of Nigeria	4½	—	—	—

† Wolfram. ‡ Mixed Concs.

SOUTH AFRICAN MINERAL OUTPUT  
May, 1958

Gold .....	1,475,273 oz.
Silver .....	145,531 oz.
Diamonds .....	214,200 carats.*
Coal .....	3,415,625 tons.
Copper .....	(a) 66 tons in matte and copper-gold concentrates. (b) 4,514 tons of 99.42%.
Tin .....	234 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude) .....	—
Asbestos .....	14,177 tons.
Chrome Ore .....	55,348 tons.
Manganese Ore .....	78,891 tons.
Lead Concs. ....	— tons.

\* Apr., 1958.

IMPORTS OF ORES, METALS, ETC., INTO  
UNITED KINGDOM

	MAY	JUNE
Iron Ore .....	1,313,514 tons	1,364,375
Manganese Ore .....	32,771	8,883
Iron and Steel .....	60,064	86,694
Iron Pyrites .....	26,297	10,156
Copper Metal .....	40,267	28,971
Tin Ore .....	6,765	3,537
Tin Metal .....	1,429	3,029
Lead .....	12,152	18,115
Zinc Ore and Concs. ....	9,688	—
Zinc .....	14,040	12,174
Tungsten Ores .....	419	399
Chrome Ore .....	19,261	8,336
Bauxite .....	28,842	32,800
Antimony Ore and Concs. ....	1,544	207
Titanium Ore .....	12,746	17,244
Nickel Ore .....	6,496	5,867
Tantalite/Columbite .....	19	19
Sulphur .....	37,189	21,692
Barytes .....	3,353	3,025
Asbestos .....	14,225	11,424
Magnesite .....	3,258	2,296
Mica .....	602	302
Graphite .....	679	127
Mineral Phosphates .....	92,626	55,002
Molybdenum Ore .....	268	287
Nickel .....	24,009	18,853
Aluminium .....	408,872	382,588
Mercury .....	147,745	60,278
Bismuth .....	86,201	33,292
Cadmium .....	149,141	258,400
Cobalt and Cobalt Alloys .....	128,657	6,709
Selenium .....	8,375	30,226
Petroleum Motor Spirit ... 1,000 gals.	68,290	51,331
Crude .....	722,662	688,691

## Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial .....	per ton	106	0	0
" " 80% Technical .....	"	97	0	0
Alum, Comm. ....	"	25	0	0
Aluminium Sulphate .....	"	16	10	0
Ammonia, Anhydrous .....	per lb.	2	0	0
Ammonium Carbonate .....	per ton	59	0	0
" Chloride, 98% .....	"	26	0	0
" Phosphate (Mono- and Di-) ..	"	102	0	0
Antimony Sulphide, golden .....	per lb.	3	0	0
Arsenic, White, 99/100% .....	per ton	47	10	0
Barium Carbonate (native), 94% ..	"	Nominal		
" Chloride .....	"	53	0	0
Barytes (Bleached) .....	"	20	0	0
Benzole .....	per gal.	5	2	
Bleaching Powder, 36% Cl. ....	per ton	30	7	6
Borax .....	"	44	0	0
Boric Acid, Comm. ....	"	75	10	0
Calcium Carbide .....	"	40	17	9
" Chloride, solid, 70/75% .....	"	13	5	0
Carbolic Acid, crude 60's .....	per gal.	8	3	
Carbon Bisulphide .....	per ton	62	10	0
Chromic Acid (ton lots) .....	per lb.	2	2½	
Citric Acid .....	per cwt.	11	0	0
Copper Sulphate .....	per ton	66	0	0
Cresote Oil (l.o.r. in Bulk) .....	per gal.	1	2	
Cresylic Acid, 97-98% .....	"	6	6	
Hydrochloric Acid 28° Tw. ....	per carboy	13	0	
Hydrofluoric Acid, 50/60% .....	per lb.	1	1	
Iron Sulphate .....	per ton	3	17	6
Lead, Acetate, white .....	"	124	0	0
" Nitrate .....	"	116	0	0
" Oxide, Litharge .....	"	106	5	0
" Red .....	"	104	5	0
" White .....	"	116	0	0
Lime, Acetate, brown .....	"	40	0	0
Magnesite, Calcined .....	"	20	0	0
" Raw .....	"	9	0	0
Magnesium Chloride, ex Wh'ise ..	"	16	0	0
" Sulphate, Comm. ....	"	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.	6	3	
Nitric Acid, 80° Tw. ....	per ton	37	10	0
Oxalic Acid .....	"	129	0	0
Phosphoric Acid (S.G. 1.750) .....	per lb.	1	4	
Pine Oil .....	per ton	Nominal		
Potassium Bichromate .....	per lb.	1	2½	
" Carbonate (hydrated) .....	per ton	74	10	0
" Chloride, 90% .....	"	21	0	0
" Iodide .....	per lb.	9	0	
" Amyl Xanthate .....	"	Nominal		
" Ethyl Xanthate .....	"	Nominal		
" Hydrate (Caustic) solid .....	per ton	118	0	0
" Nitrate .....	per cwt.	4	1	0
" Permanganate .....	per ton	193	10	0
" Sulphate, 48% .....	"	22	1	0
Sodium Acetate .....	"	99	0	0
" Arsenate, 58-60% .....	"	Nominal		
" Bicarbonate .....	"	15	0	0
" Bichromate .....	per lb.	1	0	
" Carbonate (crystals) .....	per ton	Nominal		
" (Soda Ash) 58% .....	"	13	5	0
" Chlorate .....	"	92	0	0
" Cyanide 100% NaCN basis .....	per cwt.	6	6	6
" Hydrate, 70/77%, solid .....	per ton	33	0	0
" Hyposulphite, Comm. ....	"	32	15	0
" Nitrate, Comm. ....	"	29	10	0
" Phosphate (Dibasic) .....	"	40	10	0
" Prussiate .....	per lb.	1	0½	
" Silicate .....	per ton	11	0	0
" Sulphate (Glauber's Salt) .....	"	9	15	0
" (Salt-Cake) .....	"	8	0	0
" Sulphide, flakes, 60/62% .....	"	37	2	6
" Sulphite, Comm. ....	"	27	10	0
Sulphur, American, Rock (Truckload) ..	"	17	0	0
" Ground, Crude .....	"	19	0	0
Sulphuric Acid, 168° Tw. ....	"	19	15	0
" free from Arsenic, 140° Tw. ....	"	8	3	0
Superphosphate of Lime, 18% P <sub>2</sub> O <sub>5</sub> ..	"	14	18	6
Tin Oxide .....	"	Nominal		
Titanium Oxide, Rutile .....	"	172	0	0
" White, 25% .....	"	85	0	0
Zinc Chloride .....	"	95	0	0
" Dust, 95/97% (4-ton lots) .....	"	104	0	0
" Oxide .....	"	88	10	0
" Sulphate .....	"	32	0	0

# Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:		JULY 10, 1958	AUG. 8, 1958
SOUTH AFRICA:		£ s. d.	£ s. d.
Blinkfont (5s.)		2 8 0	2 7 3
Blyvooruitzicht (2s. 6d.)		1 2 6	1 2 6
Brakpan (5s.)		4 9	4 6
Buffelsfontein (10s.)		1 18 6	1 19 3
City Deep		14 0	13 9
Consolidated Main Reef		15 0	14 9
Crown Mines (10s.)		1 3 9	1 3 0
Daggafontein (5s.)		1 9 9	1 10 3
Dominion Reefs (Ord. 5s.)		11 9	12 0
Doornfontein (10s.)		1 6 3	1 5 6
Durban Roodepoort Deep (10s.)		1 9 3	1 9 3
East Champ d'Or (2s. 6d.)		1 9	1 6
East Daggafontein (10s.)		8 6	8 3
East Geduld (4s.)		1 5 3	1 5 0
East Rand Proprietary (10s.)		1 18 9	1 18 9
Freddie's Consol.		2 9	2 3
Free State Dev. (5s.)		4 12 0	4 11 0
Free State Saaiplaas (10s.)		13 3	14 3
Geduld		3 2 6	3 2 9
Government Gold Mining Areas (5s.)		4 0	3 6
Grootvlei (5s.)		15 6	14 3
Harmony (5s.)		1 18 9	1 17 3
Hartebeestfontein (10s.)		3 5 3	3 0
Libanon (10s.)		7 9	7 6
Lorraine (10s.)		2 9	2 6
Lupaards Vlei (2s.)		9 9	9 3
Marievale (10s.)		19 6	18 3
Merriespruit (5s.)		4 0	4 0
Modderfontein B (3d.)		3 0	2 9
Modderfontein East		14 0	13 6
New Kleinfontein		10	3 9
New Pioneer (5s.)		1 15 3	1 14 0
New State Areas (16s.)		2 0	2 0
President Brand (5s.)		2 13 3	2 16 0
President Steyn (5s.)		1 9 3	1 9 3
Rand Leases (10s.)		4 0	4 0
Randfontein		1 5 0	1 3 3
Riebeeck (10s.)		16 0	15 9
Rietfontein (5s.)		8 0	8 0
Robinson Deep (7s. 6d.)		10 0	10 3
Rose Deep (10s. 6d.)		10 3	10
St. Helena (10s.)		2 2 9	2 1 6
Simmer and Jack (2s. 6d.)		4 0	3 9
South African Land (3s. 6d.)		1 1 0	1 1 3
Springs (5s.)		1 9	1 9
Stilfontein (5s.)		2 0 3	2 0 6
Sub Nigel (10s.)		13 6	13 0
Vaal Reefs (5s.)		1 16 3	1 15 6
Van Dyk (7s. 9d.)		3 3	3 6
Venterspost (10s.)		14 0	14 3
Virginia (5s.)		8 0	7 9
Vlakfontein (10s.)		16 0	15 3
Vogelstruisbult (10s.)		8 0	7 9
Welkom (5s.)		15 3	14 9
West Driefontein (10s.)		5 3 9	5 1 3
West Rand Consolidated (10s.)		1 5 6	1 5 6
West Witwatersrand Areas (2s. 6d.)		2 4 6	2 5 9
Western Holdings (5s.)		5 0	4 19 0
Western Reefs (5s.)		1 5 9	1 8 0
Winkelhaak (10s.)		17 0	16 9
Witwatersrand Nigel (2s. 6d.)		1 6	1 3
RHODESIA:			
Cam and Motor (2s. 6d.)		8 3	8 0
Chicago-Galka (10s.)		15 0	15 0
Coronation (2s. 6d.)		3 9	3 6
Falcon (5s.)		7 6	7 6
Globe and Phoenix (5s.)		1 8 3	1 8 0
Motapa (5s.)		7	6
GOLD COAST:			
Amalgamated Banket (3s.)		1 0	1 0
Ariston Gold (2s. 6d.)		4 0	4 0
Ashanti Goldfields (4s.)		15 6	15 9
Bibiani (4s.)		2 1	2 0
Bremang Gold Dredging (5s.)		1 6	1 3
Ghana Main Reef (5s.)		1 9	1 9
Konongo (2s.)		1 6	1 7
Kwahu (2s.)		3 0	3 0
Taqaah and Abosso (5s.)		—	—
Western Selection (5s.)		4 3	4 3
AUSTRALASIA:			
Gold Fields Aust. Dev. (3s.), W.A.		1 6	1 6
Gold Mines of Kalgoorlie (10s.)		9 3	8 9
Great Boulder Proprietary (2s.), W.A.		12 3	12 9
Lake View and Star (4s.), W.A.		1 2 6	1 2 9
London-Australian (2s.)		9 9	9 9
Mount Morgan (10s.), Q.		8 9	10 6
New Guinea Gold (4s. 3d.)		1 3	1 6
North Kalgurli (1912) (2s.), W.A.		7 6	7 6
Sons of Gwalia (10s.), W.A.		2 3	2 3
Western Mining (5s.), W.A.		8 6	8 0

## MISCELLANEOUS:

Fresnillo (\$1-00)	
Kentana Gold Areas (1s.), E. Africa	
St. John d'el Rey, Brazil	
Yukon Consolidated (\$1)	

## COPPER:

Bancroft Mines (5s.), N. Rhodesia	16 9	1 0 6
Eacranza (2s. 6d.), Cyprus	1 6	1 9
Indian (2s.)	3 9	4 6
Magundi (5s.)	2 6	3 0
Messina (5s.), Transvaal	4 14 3	4 13 3
Mount Lyell, Tasmania	16 3	18 6
Nchanga Consolidated, N. Rhodesia	10 0 0	10 17 3
Rhokana Corporation, N. Rhodesia	26 5 0	27 0 0
Roan Antelope (5s.), N. Rhodesia	8 0	8 3
Tanganyika Concessions (10s.)	2 19 6	3 2 0

## LEAD-ZINC:

Broken Hill South (5s.), N.S.W.	2 6 3	2 4 6
Burma Mines (3s. 6d.)	2 1 9	2 1 9
Consol. Zinc Corp. Ord.	2 7 6	2 9 3
Electrolytic Zinc, Tasmania (Pref. 5s.)	2 12 6	2 12 6
Lake George (5s.), N.S.W.	4 9	6
Mount Isa, Queensland (5s. Aust.)	1 2 9	1 4 0
New Broken Hill (5s.), N.S.W.	1 12 9	1 12 6
North Broken Hill (5s.), N.S.W.	3 14 6	3 15 0
Rhodesia Broken Hill (5s.)	7 9	7 9
San Francisco (10s.), Mexico	18 0	17 6

## TIN:

Amalgamated Tin (5s.), Nigeria	5 0	5 0
Ampat (4s.), Malaya	6 6	6 0
Ayer Hitam (5s.), Malaya	1 3 6	1 2 6
Beralit (5s.), Portugal	1 7 6	1 5 0
Bisichi (2s. 6d.), Nigeria	2 9	2 9
Ex-lauds (2s.), Nigeria	1 1	1 9
Geowor (5s.), N.W. Africa	14 9	13 0
Gold Base Metals (2s. 6d.), Nigeria	—	—
Hongkong (5s.), Malaya	4 3	4 0
Jantar Nigeria (3s.)	2 0	2 0
Kaduna Syndicate (2s.), Nigeria	2 0	2 0
Kamunting (5s.), Malaya	8 0	8 3
Kramat Pulai (3d.), Malaya	2 9	3 0
Malayan Tin Dredging (5s.)	10 6	9 9
Mawchi Mines (4s.), Burma	1 6	1 6
Naraguta Extended (5s.), Nigeria	9 9	9 9
Pahang (5s.), Malaya	4 0	4 0
Siamense Synd. (5s.)	6 3	6 6
South Crofty (5s.), Cornwall	4 3	3 0
Southern Kinta (5s.), Malaya	16 3	15 9
Southern Malayan (5s.)	8 0	8 3
Southern Tronoh (5s.), Malaya	8 0	7 6
Sungei Besi (4s.), Malaya	13 0	13 9
Sungei Kinta, Malaya	14 0	12 6
Tronoh (5s.), Malaya	10 3	9 9
United Tin Areas (2s. 6d.), Nigeria	4 1	4 1

## DIAMONDS:

Anglo African Investment	8 15 0	9 7 6
Consol African Selection Trust (5s.)	14 3	13 6
Consolidated of S.W.A. Pref (10s.)	10 6	11 0
De Beers Deferred (5s.)	5 3 0	5 5 0

## FINANCE, ETC.

African & European (10s.)	3 5 6	3 6 3
Anglo American Corporation (10s.)	7 6 3	7 9 0
Anglo-French Exploration	1 3 6	1 3 0
Anglo Transvaal 'A' (5s.)	1 12 3	1 12 0
British South Africa (15s.)	3 4 0	3 7 0
British Tin Investment (10s.)	15 9	14 0
Broken Hill Proprietary	1 17 0	1 18 0
Camp Bird (10s.)	11 3	10 9
Central Mining	3 4 0	3 4 9
Central Provinces Manganese (10s.)	1 8 9	1 9 0
Consolidated Gold Fields	2 15 0	2 14 0
Consolidated Mines Selection (10s.)	1 15 0	1 14 3
East Rand Consolidated (5s.)	1 3	1 3
Free State Development (5s.)	5 6	5 6
General Exploration O.F.S. (2s. 6d.)	2 3	3 4
General Mining and Finance	4 15 0	4 16 0
H.E. Proprietary (5s.)	8 3	8 6
Johannesburg Consolidated	2 11 0	2 6 0
London & Rhod. M. & L. (5s.)	7 9	7 6
London Tin Corporation (4s.)	7 0	7 0
Lydenburg Est. (5s.)	14 0	13 0
Marsman Investments (10s.)	2 18 3	3 1 0
National Mining	1 6	1 6
Rand Mines (5s.)	3 17 0	4 1 0
Rand Selection (5s.)	1 19 3	2 1 0
Rhodesian Anglo American (10s.)	3 8 6	3 14 0
Rhodesian Corporation (5s.)	3 9	3 9
Rhodesian Selection Trust (5s.)	15 0	16 0
Rio Tinto (10s.)	2 18 3	3 1 0
Selection Trust (10s.)	3 18 9	4 8 0
South West Africa Co. (3s. 4d.)	16 3	16 3
Union Corporation (2s. 6d.)	2 3 0	2 4 6
West Rand Inv. Trust (10s.)	2 8 3	2 8 3
Zambia Exploring	2 3 6	2 4 0

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# THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

*In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.*

## Heated Screens

Some information on the problem of heating vibrating screens electrically to prevent binding has been released recently by the General Electric Co., Ltd. The provision of such heating in a quarry installation has proved its effectiveness. Four standard 4 ft. by 10 ft. double-deck mechanically-vibrated Gyrex screens have been supplied for sizing crushed rock to  $\frac{3}{8}$  in. in size with about 30% below  $\frac{1}{8}$  in. The screens were fitted with  $\frac{7}{8}$ -in. and  $\frac{3}{8}$ -in. square-mesh high-tensile steel-wire screen cloths. In rainy weather, although the overall moisture of the rock might not be more than 5%, the fines would contain 10% to 12% of water and this material would completely blind the lower  $\frac{3}{8}$  in. screen in about half-an-hour. Screening had then to be stopped and the meshes cleaned by hand with wire brushes before operations could be resumed. Conditions were not much better in dry weather because water sprays had to be employed at transfer points in the conveyor system to keep down the dust and the fines were still too damp to be screened satisfactorily.

To overcome these difficulties it was decided to fit heating equipment to the lower screen cloths. The conversion was carried out in collaboration with the Woden Transformer Co., Ltd., and has

been very successful. The  $\frac{3}{8}$ -in. oversize is now virtually free from undersize, however wet the fines may be. The screen temperature is regulated at 40° C. for most of the year, but it can be dropped as low as 30° C. in very hot weather. The throughput is about 25 tons per hour. The cost works out at 0.75d. per ton of screen feed with power at 1d. per unit.

At another installation, the company says, a coal preparation plant at Blaengarw in South Wales—supplied and erected by the G.E.C. engineering works for the National Coal Board—four 4 ft. by 10 ft. Sherwen electromagnetic vibrating screens had been installed for sizing *minus*  $\frac{3}{8}$ -in. coal on  $\frac{1}{8}$  in. It was found that the coal coming up from the pit carried from 4% to 7% moisture with 8% to 12% in the fines, making effective screening virtually impossible. The installation of heating equipment again overcame the difficulty. The accompanying table shows the great improvement that was obtained with the heated screen cloths.

Fig. 1 shows the way in which the electric heating equipment is fitted. The screen cloth is divided longitudinally into two separate sections, which are insulated from the frame and from each

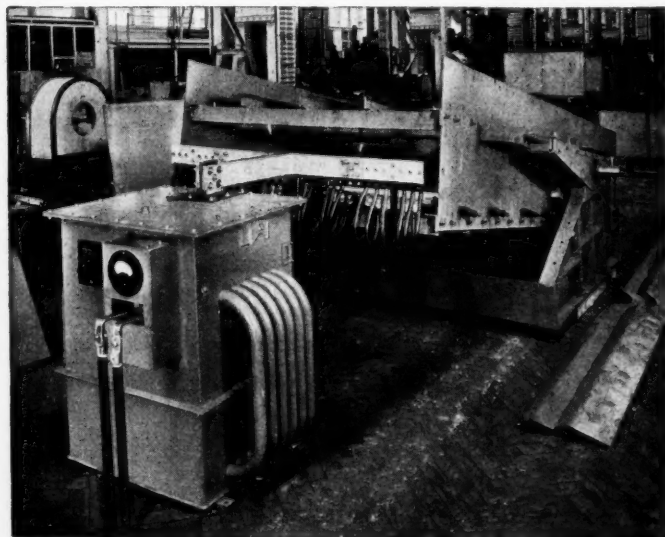


Fig. 1.—  
Double-Deck  
Screen, with  
Heating of  
Lower Deck.

## Performance of Washery Screens with and without Heating

Screen size.	Raw coal feed to screen. %	Overize on Screen cloth unheated. %	in. slotted screen Screen cloth heated. %
<i>International Coal</i> (4.4% moisture)			
— $\frac{3}{8}$ in. + $\frac{1}{4}$ in.	23.7	35.0	56.3
— $\frac{1}{4}$ in. + $\frac{1}{8}$ in.	20.0	27.5	28.1
— $\frac{1}{8}$ in. + $\frac{1}{16}$ in.	23.1	21.9	7.5
— $\frac{1}{16}$ in. + 30 mesh	14.5	4.9	3.7
— 30 mesh + 60 mesh	9.4	3.8	1.8
— 60 mesh	9.3	6.9	2.6
	100.0	100.0	100.0
$\frac{1}{8}$ in. by 0 in. oversize		37.5	15.6
$\frac{1}{16}$ in. by 0 in. oversize		15.6	8.1
<i>Garw Coal</i> (6.7% moisture)			
— $\frac{3}{8}$ in. + $\frac{1}{4}$ in.	18.6	25.2	55.4
— $\frac{1}{4}$ in. + $\frac{1}{8}$ in.	16.7	20.1	25.8
— $\frac{1}{8}$ in. + $\frac{1}{16}$ in.	22.4	22.6	8.8
— $\frac{1}{16}$ in. + 30 mesh	15.4	13.8	3.8
— 30 mesh + 60 mesh	11.7	9.3	2.2
— 60 mesh	15.2	9.0	4.0
	100.0	100.0	100.0
$\frac{1}{8}$ in. by 0 in. oversize		54.7	18.8
$\frac{1}{16}$ in. by 0 in. oversize		32.1	10.0
<i>Ogmore Coal</i> (4.2% moisture)			
— $\frac{3}{8}$ in. + $\frac{1}{4}$ in.	16.3	38.6	52.8
— $\frac{1}{4}$ in. + $\frac{1}{8}$ in.	17.6	35.4	35.3
— $\frac{1}{8}$ in. + $\frac{1}{16}$ in.	23.3	17.1	7.5
— $\frac{1}{16}$ in. + 30 mesh	18.0	3.7	1.4
— 30 mesh + 60 mesh	11.8	1.8	0.9
— 60 mesh	13.0	3.4	2.1
	100.0	100.0	100.0
$\frac{1}{8}$ in. by 0 in. oversize		26.0	11.9
$\frac{1}{16}$ in. by 0 in. oversize		8.9	4.4

other by long strips of non-conducting material. The ends are clamped between bars of tinned steel, to which terminals are attached. Low-voltage current is supplied by a Woden "Clear-Mesh" heating transformer. It is taken from one of the busbars on the low-tension side of the transformer to terminals on the top of one of the longitudinal sections by means of rubber-covered cables. The current passes through the wires of the screen to its lower edge, from which it is led by cables or copper strips to the bottom of the other section. Thence it passes up the wires to the upper edge, from which cables connect it with the other busbar of the transformer.

Sherwen screens are tensioned longitudinally and the screening surface consists of a single length of screen cloth. The electrical connexions have therefore only to be made at the upper and lower edges of each longitudinal section. Gyrex screens are tensioned laterally and the screen cloths, except in the smallest size, are made up of a number of standard panels in order to facilitate screen replacements and reduce the number of spare cloths to be carried. Each separate panel has therefore to be divided longitudinally and fitted at the upper and lower edges with tinned-steel clamp bars. Terminals are fixed on the underside and adjacent half-panels

are connected up by short loops of insulated cable under the screen cloth. The feed is normally directed on to the screen several inches below the upper edge and thus it does not come into contact with the terminals and cables there. No precautions are taken, however, to protect the intermediate cables or the connexions at the lower edge. The latter have to be renewed at comparatively long intervals, but the intermediate cables are unaffected.

In general, the temperature that has to be maintained on the screening surface ranges from about 30° C. to 40° C. In exceptional cases, when a temperature of more than 40° C. is necessary, special precautions have to be taken to prevent overheating of the screen cloth if the feed should be cut off. These consist of "flow switches," which come into operation to reduce the current directly the feed ceases to flow. The power needed to heat the screening surface depends on the gauge of the wires composing the meshes and on the temperature to be maintained. In general the cost of operating heated screens ranges from  $\frac{1}{2}$ d. to 1d. per ton of feed material.

Particulars of the installation at the Blaengarw Washery and the results obtained are published by permission of the National Coal Board.

## Diamond Mining in South-West Africa

A paper by C. P. A. Louwrens in the *Journal of the South African Institute of Mining and Metallurgy* for June deals with "Earthmoving in the Diamond Mines of Southern Africa." The notes reproduced here are taken from a section dealing with the open workings of the Consolidated Diamond Mines of South-West Africa, Ltd., at Oranjemund. The old marine beaches which contain diamondiferous gravels are covered by a blanket of sand up to 40 ft. deep. The problem at Oranjemund was two-fold—first, the exact location of the diamondiferous terraces so that ore reserves could be clocked out and, secondly, the mining of these terraces.

### Stripping Overburden

For the speedy development of the alluvial fields a great deal of sampling had to be carried out. Sampling trenches, often up to two miles in length, were excavated at intervals of 1,000 metres from the Orange River for a distance of about 70 miles up the coast. Each trench starts from the sea and is excavated to bedrock. The trenches run at right-angles from the sea to a point inland where the bedrock is approximately 100 ft. above sea-level. The size of the prospecting operations can be gauged from the fact that in the 10 years, as mentioned, one-third of the 81,500,000 tons of sand removed was for the purpose of stripping sand from prospecting trenches.

The most successful machine for stripping sand for prospecting was the diesel-driven, rubber-tyred, four-wheel scraper fitted with giant tyres. These machines are fast and mobile, often operating up to 100 miles from Oranjemund. Sand is removed to the depth of the gravel beds which may be anything from a few feet to 40 ft. deep over a width of up to 120 ft. on the surface. The mine records show that in the years 1954 to 1957 30 10-ton capacity scrapers removed 12,500,000 cu. yd. of sand at an average rate of 57.5 cu. yd. per hour at a direct overall cost of 10d. per cu. yd., pusher tractor costs included. The average round trip of the scraper was from half to one mile. Push loading is done by means of a track-type tractor which handles, on the average, three scrapers.

Although most of the stripping for prospecting was carried out by rubber-tyred scrapers during the years 1954 to 1957, up to 19  $\frac{3}{4}$  cu. yd. draglines with 55-ft. booms were used for deep stripping, sometimes up to 50 ft. deep and particularly in places below sea-level where the inflow of salt water considerably hindered other forms of earthmoving. A very useful function was performed by these draglines in making deep water-holes in the sand next to the sea for the purpose of establishing pump stations for the supply of sea-water to screening and washing plants.

For the four years 1954 to 1957 the draglines, which are diesel-driven, removed 3,930,000 cu. yd. of overburden at an average rate of 37.5 cu. yd. per hour and at a total direct cost of 12.65d. per cu. yd.

For large-scale stripping bucket-wheel excavators, also referred to as "scoops," are the most successful. These large scoops are either diesel-electric driven or else directly powered by electric power supplied through a trailing cable. They weigh 97 tons each and travel at  $\frac{1}{2}$  m.p.h. Although very few parts of the original machines still exist the principle of their operation still persists. For instance, all

motors and gearboxes have been replaced by local articles, as have the original conveyors and cutting wheels, while the track plates have been replaced with American-made manganese plates on the pattern used for heavy gun carriages during the war and the original diesel engines have been replaced by modern engines made in Britain.

These machines have supplied the answer to high-capacity, low-cost earthmoving. In contrast to most earthmoving machines, which work on a batch principle, the scoops work on a continuous principle and at a low relative power consumption. For example, the operating horsepower, while producing at a rate of 300 cu. yd. per hour, is only about 40 h.p. Wherever possible the scoops are powered from the electric power network by means of trailing cable, while use is made of the diesel-electric drive only under unusual conditions when no electric power is available.

For the period 1954 to 1957 the three bucket wheel-excavators, each in series with an average of two portable stackers, removed 9,100,000 cu. yd. of sand over an average distance of 250 ft. at a rate of 230 cu. yd. per hour per machine, at a direct cost of 5.85d. per cu. yd., stacker costs included.

With the rapid expansion at Oranjemund it soon became evident that much more equipment was required to strip overburden from the mining faces and that a machine working on a continuous principle like the old bucket-wheel excavators was the most desirable. As such machines were not available after World War II it was decided to design, develop, and build suitable excavators at the mine. Sherman tanks, having first served as tractors to rubber-tyred scrapers, were stripped down to bare essentials and converted into small bucket-wheel excavators. These small scoops weigh 25 tons each and are powered by a 40-h.p. electric motor which receives electric power at 500 V from a rubber trailing cable. The electric motor is coupled to the propeller shaft and gearbox, which is left permanently in the lowest gear ratio, giving a travelling speed of up to 1  $\frac{1}{2}$  m.p.h. Reversing is accomplished electrically from a horizontally-mounted drum controller. The steering clutches of the tank are connected to suitable electro-hydraulic thrustors and a similar thrustor on the propeller shaft acts as a holding brake. As these small scoops have no diesel engines a portable diesel generating set on a 10-ton rubber-tyred trailer coupled to the excavator is used to supply propelling power to move the machines overland. When on site the machines are linked up to the power network at the working places.

During the period 1949 to 1952 14 such small bucket-wheel excavators were assembled at the mine with parts supplied under contract to given drawings and specifications. For the four years 1954 to 1957 these machines moved 16,260,000 cu. yd. of sand and, with the aid of the portable stackers, backfilled worked-out areas at an average rate of 113.2 cu. yd. per hour and at a direct cost of 8d. per cu. yd., stacker costs included.

Without portable stackers to take the sand away the bucket-wheel excavators would be ineffective. Usually two stackers work in series with a scoop, but up to four have been used. Two give the most efficient operation. Stackers form such an integral part of scoop operation that the cost of stacker

operation is always included in that of the scoop. As in the case of the small bucket-wheel excavator the portable self-propelling stackers were constructed at the mine, using the basic structure and mechanism of a Sherman tank together with electric power supplied by trailing cables. The drum controller for starting, stopping, and reversing can be actuated from either side of the machine and, similarly, push-button stations are duplicated for steering (by means of the thrusters), starting, and stopping the conveyor-belts.

The stacker belt has a horizontal reach of approximately 90 ft. and the height above ground at either end is adjustable. The operator walks on the ground on the side of the machine.

A very interesting machine that was acquired in 1948 is the tower-mounted crescent scraper. The head tower is 110 ft. high and weighs 500 tons. The motive power is supplied by a 5,000-V electric trailing cable and the main motor is of 350 h.p. capacity. The 6-cu. yd. crescent scraper can clear a length of up to 900 ft. between towers by making a dump at the head end. The inhaul speed of scraping is 350 ft./min., while the return of the scraper, which then hangs on the aerial cable, is at a rate of 750 ft./min. One operator controls the entire operation, including the movement of the tail tower, from his operating position 90 ft. from the ground in the head tower. Powerful lights mounted on the towers allow operation at night. The towers can move at  $\frac{1}{2}$  m.p.h. on their caterpillar-type tracks.

During the four years 1954 to 1957, the tower scraper moved 1,320,000 cu. yd. of sand at an average rate of 195 cu. yd. per hour and at a direct cost of 9-35d. per cu. yd.

#### Mining Gravel

After the stripping of overburden is complete the diamondiferous gravels are loaded, and conveyed to the nearest screening plant. There are 13 of these plants at regular intervals so that no gravels have to be transported for more than about two miles. The area to be excavated at a working face is usually about 300 ft. long by 200 ft. wide. The diamondiferous terrace contains up to 80% of sand and up to 20% of oversize boulder—i.e., + 1 in. material which is removed at the screening plant and dumped. The - 1 in. + 9 mesh material is sent in trains of 10-ton capacity railway trucks hauled by 25-ton electric locomotives to the central concentration plant, where the diamonds are extracted. Originally the gravels were hand-loaded into 35-cu. ft. cocopans and hauled by means of 5-ton diesel locomotives to the nearest screening plant. A marked improvement has resulted from the use of a  $\frac{3}{4}$ -cu. yd. diesel-operated mechanical shovel loading gravels into the cocopans. Final cleaning up of the irregular bedrock has always been completed by hand.

The  $\frac{3}{4}$ -cu. yd. excavator matched very well with both the cocopans and the thickness of the diamondiferous terrace on the bedrock. This terrace is usually from 3 ft. to 6 ft. thick but it does occur in thicknesses of a few inches to 10 ft. When the decision was made in 1952 to use 10-ton capacity rubber-tyred dumpers with sand tyres it was possible to improve the operation, where thick terrace existed, by employing  $1\frac{1}{2}$ -cu. yd. excavators.

It soon became evident that shovels which are driven by electric motors and trailing cable were more economical and harder digging machines. As a result it is now established policy to convert diesel-driven shovels as soon as they can operate near the power network. This is quite an extensive distribution system consisting of two 30-kV main pole lines of about 40 miles in length each, with suitable 250-kVA transformers stationed along the line to give 500-V. The diesel-operated machines are, however, most useful and versatile for advance work.

In the four years 1954 to 1957  $1\frac{1}{2}$ -cu. yd. capacity diesel-driven excavators loaded 3,380,000 cu. yd. of terrace at an average rate of 43-5 cu. yd. per hour into suitable transport vehicles at a direct cost of 12-2d. per cu. yd. This is compared with the operation of seven similar machines which are, however, electrically operated and which loaded 1,489,000 cu. yd. of terrace at an average rate of 37-9 cu. yd. per hour and at a direct cost of 4-8d. per cu. yd. over the same period of time.

The corresponding statistics for the seven  $1\frac{1}{2}$ -cu. yd. diesel-driven shovels showed 3,920,000 cu. yd. of terrace loaded at an average rate of 91-2 cu. yd. per hour at a direct cost of 5-97d. per cu. yd., while the three  $1\frac{1}{2}$ -cu. yd. electrically-operated machines in 1956 and 1957 loaded 789,000 cu. yd. of terrace at an average rate of 86-8 cu. yd. per hour and at a direct cost of 2d. per cu. yd. The latter figure cannot be taken as a fair average because the machines were too new during the two years when the figures were taken.

Up to 1952 the transport of terrace to the screening plants was by means of 35-cu. ft. capacity cocopans and 5-ton diesel locomotives. A scheme which was embarked upon with some trepidation turned out to be most successful. After a great deal of investigation it was decided to supersede "truck and track" with rubber-tyred, self-propelling, rear-dumping transport vehicles. The large sand tyres have no difficulty in negotiating the soft sand and roadways need only be levelled off for good average speeds up to 25 m.p.h. The rubber-tyred transport has proved very much more versatile, faster, and it can serve twice the area than can "truck and track." Rubber-tyred vehicles are also more flexible, give much better transport efficiency, and a great saving in labour is possible. Further advantages gained are the rapid exploitation of new areas without having to lay track and the very much reduced maintenance costs on roadways as against railway track, which deteriorates very quickly at the coast.

The success of the dumpers is illustrated by the fact that the number of vehicles in use was increased from 32 in 1954 to 53 at present. Due to improved maintenance the direct overall running cost per hour of these machines has been reduced from 25s. 8d. in 1954 to 20s. 4d. in 1957. On account of the greatly varying transport distances no overall figure for the cost per cu. yd. can be given. For a one-mile round trip one rear dumper can deliver about 30 cu. yd. per hour running at an average speed of 15 m.p.h., including loading and discharging, at a cost of 8-1d. per cu. yd.

## Fluorite Flotation

A review of the main principles of the production of acid-grade fluorite by flotation is given in Information Circular No. 4 issued by the C.S.I.R.O. ore-dressing laboratory at the University of Melbourne. Concentration by flotation, the Circular states, is by now a fairly well established procedure in which the mineral is floated with oleic acid from slightly alkaline heated pulps, the gangue minerals being depressed by a combination of reagents. Softened water is normally used and the flotation circuitry is complex as a result of the stringent buyers' requirements for the acid-grade products.

### Flotation with Oleic Acid

Fluorite is probably one of the most easily floatable of the polar non-metallic minerals and floats readily with oleic acid over a wide range of particle sizes, the range for maximum flotability being somewhere between 65 mesh and 200 mesh. Frequently no frothing agent is required, although it is sometimes considered advisable to add small amounts of frother in order to impart the desired degree of brittleness to the froth; pine oil or frother B23 are satisfactory for this purpose. Sulphated fatty acids and esterified glycerides—e.g., Emulsol X1, Emcol X25, Syntex M—are often used in conjunction with oleic acid, presumably to emulsify the collector and facilitate its application and to function to some extent as froth modifiers. These reagents may also act as collectors for fluorite, although whether this was generally recognized is not clear.

Fluorite floats over a wide pH range, the most commonly recommended value lying somewhere between pH8 and pH9. It seems likely that pH control is not very critical although values below about 7 may result in reduced recoveries. Sodium carbonate is used almost exclusively as pH modifier in practice presumably to avoid the deliberate introduction of calcium ions consequent upon the use of lime. It is probable too that sodium carbonate is more effective than lime in aiding gangue dispersion.

### Anionic Collectors

Long-chain organic acids, other than oleic acid, have been used successfully as fluorite collectors. Mixtures of linoleic and linolenic acids, which are similar to oleic acid but with greater degrees of unsaturation, are possibly the commonest of these and have been used both in the laboratory and in practice. Somewhat lower flotation temperatures may be used as the unsaturation of the collector increases. Stearic acid is said to behave similarly to oleic and reagents 708 (mixed vegetable fatty acids) and 825 (petroleum mahogany sulphonic acids) of the American Cyanamid Co. have also been used. Lower flotation temperatures are also possible with oxidized products of paraffin and the mixed carboxylic acids obtained from them.

Paraffin chain salts have been used with varying degrees of success. Of these sodium oleate is probably the best known, but because of its similarity to oleic acid need not be discussed further. Less well known are the sulphate and sulphonate esters of aromatic and long-chain aliphatic alcohols—principally the latter—which have been used a number of times. The most promising of these are the sodium alkyl sulphates represented by sodium

cetyl sulphate, which are effective over a wider pH range than oleic acid—presumably because they are ionic over a much wider range—and are effective at lower temperatures. This means that flotation may be carried out at lower pH values with less likelihood of quartz activation by metallic ions. In addition only iron ( $\text{Fe}^{2+}$ ) and lead ions are activators for quartz with sodium cetyl sulphate.

The Aerosol reagents (Aerosols O.T. and M.A.) which are alkyl sulphonates are interesting in that they are not collectors for calcite but are efficient fluorite collectors and few anionic reagents fall into this category. Moreover they appear to be one of the most effective collectors at room temperature. From these points of view further investigation of the Aerosols is warranted; being anionic reagents they do not float quartz.

### Cationic Collectors

Lauryl—and cetyl—amine hydrochlorides are efficient fluorite collectors but also float calcite and quartz. As a result they are not used to any extent. In one instance, however, an amine acetate was used to clean a rougher concentrate produced in the normal manner with oleic acid, but no special advantages for this practice are evident. The use of quaternary ammonium salts in this way could perhaps be helpful for many of these are not collectors for calcite—e.g., cetyl trimethyl ammonium bromide.

In some respects it is surprising that cationic collectors have not been more fully investigated for they possess two distinct advantages over anionic reagents—namely, (1) elevated temperatures are not required and (2) they are seldom affected by the presence of cations to the same extent. On the other hand, acid conditions are necessary for quartz depression and this is not always desirable or even possible in the presence of calcite.

### Pretreatment of Pulp

Although it is commonly agreed that heating of the pulp is beneficial there is considerable difference of opinion in the literature concerning the optimum conditions. Usually the selected temperature is maintained in all stages of flotation, but where the boiling treatment is favoured it is normally done between cleaner stages or immediately before final cleaning. An unusual treatment involves the dry grinding of the ore in the presence of collector followed by heating—sometimes to 200° C.—before pulping and flotation.

The advantages claimed for heated circuits are a reduction in the quantity of collector required and a more efficient separation between fluorite and gangue, which has been attributed to a stronger binding between the collector and fluorite. The effect would therefore seem to be the result of an increased rate of flotation of fluorite compared with that of other minerals present.

Heating is most generally accomplished by means of steam injection and as far as is known no commercial treatment involves the boiling of the pulp.

With some exceptions there is agreement that softening of the water used in the flotation of fluorite with oleic acid is necessary for the attainment of optimum results, although the reason for the beneficial effect is not entirely clear. A widely-accepted opinion is that softening removes from the

water the ubiquitous calcium and magnesium ions which would otherwise remove collector from solution as insoluble oleates, thereby causing a decrease in fluorite recovery or an increase in collector consumption and frequently a decrease in concentrate grade owing to the indiscriminate smearing of all particles by the hydrophobic precipitate. A more reasonable explanation perhaps is that the removal of cations by water softening removes those which would otherwise function as gangue activators, notable among which are the ions of calcium, barium, copper, iron, lead, and aluminium, all of which may be present to a greater or lesser extent in fluorite ores. If this be so it would seem that the use of metal-sequestering compounds might with advantage be more fully investigated.

In contrast with the treatment of a large number of non-metallic minerals the desliming of fluorite ores before flotation is the exception rather than the rule and for the most part slime dispersion is sufficient to ensure efficient separation. The addition of dispersants does not appear to have any adverse effect on fine fluorite, which floats readily. Sodium silicate is widely used as a slime dispersant.

#### Flotation Circuits and Cells

Flotation circuits for the production of acid-grade fluorite are complex by most standards, requiring multi-stage cleaning to produce a suitable product. Although the number of cleaning stages will obviously depend on the nature of the ore treated the use of four cleaners is fairly common, but more are used if necessary. In these circumstances the treatment of finely-disseminated ores can often lead to difficulties in the cleaning circuits brought about by the production of a large middling load, the circulation of which often interferes with the proper functioning of the section. The use of a separate middling retreatment section would then appear desirable; alternatively the middling may be removed as such and sold as lower-grade products.

Pulp densities for rougher flotation vary from 17% to 40% solids, the average value being about 30%. High densities seem to be favoured when fluorite is to be floated after preliminary sulphide flotation.

No special flotation cells are required for fluorite flotation and almost all the commercial producers use Denver Sub-A machines. In a few cases these are modified by the fitting of moulded rubber, recessed disc impellers and sometimes by the use of diffusers in the cleaner circuits to produce a quiet cell surface condition. Deep-type cells are sometimes used for the same reason. Owing to the frothing characteristics of non-metallic collectors positive air control during flotation is often desirable.

#### Concentrate Handling

Concentrates are normally thickened, filtered, and dried to reduce the moisture content to below about 0.5%. Drying is carried out in rotary driers at temperatures of the order of 200° C., which process also serves to remove any organic material either inherently present or acquired during flotation.

#### Separation from Gangue Minerals

**Sulphides.**—Where these are present they are removed by preliminary sulphide flotation which follows the usual pattern. Although this does not normally affect fluorite flotation caution is necessary if aerofloat reagents are used, for these may have a deleterious effect on calcite depression.

**Quartz.**—Pure quartz is not floated by anionic collectors but is readily activated by many cations; the main problem therefore in fluorite flotation is the prevention of quartz activation rather than quartz depression as such. This is achieved readily in circuits of low pH value where the competition for the quartz surface provided by hydrogen ions is more than sufficient to prevent activation. A great deal of success has attended the use of alkali silicates, phosphates, and fluorides, of which the first are the most popular. The mechanism of the action of these compounds in preventing quartz flotation is not understood at the present time.

A preferred method for separating fluorite from quartz would seem to be the cationic flotation of the latter which is usually present in smaller amounts than the fluorite. However, this has not been successful up to date.

**Calcite.**—The separation of fluorite from calcite is much more difficult than from quartz, for calcite floats readily with oleic acid and other anionic collectors. In view of the common cation, cationic reagents would be expected to give the required selectivity in flotation. This has not been observed in practice, however, and better separations have been achieved using oleic acid with a variety of depressants, among which are the alkali silicates and phosphates, divalent and trivalent metal ions, oxidizing agents, and tannins. Sodium silicates and phosphates exert some depressing action on calcite but are not sufficient alone to permit clean separation. The action of these reagents is said to be improved in the presence of inorganic or short-chain organic acids, although the mode of action of this reagent combination is obscure, particularly when the pH of flotation is commonly about 8.5. Improved results are obtained if the silicates are combined with heavy-metal cations, of which copper is the most widely used. This type of behaviour is not uncommon in non-metallic flotation and has been termed "depression sensitization."

Possibly the most successful of all the reagents used for calcite depression, however, is tannic acid which was first used as long ago as 1934 and which has since been used largely in the form of quebracho although other sources have been suggested. Quebracho must be used with some care, however, for in the presence of metal cations it may act as a severe depressant for fluorite, although this is not likely to be a serious disadvantage where water softening is used. A further advantage of quebracho is that it is a powerful sulphide depressant so that the need for complete prior removal of sulphides may be less acute. Because of its ready oxidation the use of quebracho in conjunction with the oxidizing agents referred to previously is not likely to be successful.

**Barite.**—The presence of barite considerably increases the difficulties of production of acid-grade fluorite. Barite is preferably removed by preliminary gravity treatment but where this is not possible one of two procedures may be adopted. In one the barite is floated first by using alkyl sulphate collectors such as Duponol L.S., Emulsol X-1, or sodium lauryl sulphate; depressants for fluorite include citric acid and chromium nitrate either alone or in combination, citric acid and aluminium sulphate, copper or iron (Fe<sup>++</sup>) sulphate, or one of a series of protective colloids (starch, dextrin, lignin) in combination with aluminium salts. After the removal of barite fluorite is floated in the normal manner with oleic acid.

## Shaft-Sinking Grab Carriage

In the *South African Mining and Engineering Journal* for June 20 there is a description of a shaft-sinking carriage for vertical circular shafts developed at Hartebeestfontein Gold Mining. It has been designed to permit vertical, radial, and circumferential movement of a pneumatically-operated Cactus grab. Designed for a loading rate of 120 tons an hour using a 20-cu. ft. grab, the capacity in practice is in the range of 90 tons to 150 tons an hour according to the nature of the broken rock. Circumferential traverse is at a rate of two revolutions per minute and the vertical movement is at 60 ft. a minute. A complete loading cycle is achieved in about 25 seconds.

A universal joint couples the grab to a clevis screwed to the piston rod of a lifting cylinder which is suspended from a trolley located within the horizontal boom of the grab carriage, a universal joint coupling these two components. Traverse of the trolley is by means of a boom cylinder located within the boom which is itself fixed to the underside of an "inner" box operated vertically within an "outer" box. The smooth travel of box within box is achieved by means of rollers, eight rollers being spaced on the boom side and 10 rollers on the opposite side.

Vertical movement of the inner box is by means of a telescopic cylinder with a stroke of 7 ft. The box cylinder is hinged to the top cover of the outer box and the piston rod of this cylinder is screwed to a clevis fixed around channel irons forming the boom which in turn is integral with the inner box. The outer box is fixed to the bottom deck of the sinking stage by means of a thrust race spacer plate bolted to the box and forming a spacer between two horizontal thrust races encased in the housing. The housing itself is bolted to the R.S.J.s forming the aperture for the grab carriage in the bottom deck of the stage.

The upper thrust race retainer ring and circular rack supporting ring are bolted to the thrust race box. The circular rack consists of an upper and lower roller retainer ring separated by a spacer ring. Duplex pinion meshing within the circular rack is fixed to the output shaft of a gearbox secured to the side of the outer box and driven by a 10-h.p. air motor bolted to the top of the gearbox.

On the top of the outer box a rotary gland is fixed which is designed to permit of rotary movement in relation to the fixed air and water lines. Air and water supplies and exhaust pipelines are connected from the rotary gland to air and water manifolds fixed to the outside of the outer box. These

reversing valves are connected to the water manifold to operate the grab-lifting cylinder, boom cylinder, and telescopic box cylinder.

Two similar control valves are also connected to the air manifold to operate the air motor and grab.

Except where flexibility is required air and water lines are of steel tubing; elsewhere high-pressure flexible rubber hose is used. All air and water supplies are transferred from the rotary gland to the cylinders and grab by means of telescopic pipes concealed within the telescopic boxes to serve lines to and from the grab-lifting cylinder and also lines to and from the grab. Pipelines passing along the length of the grab-lifting cylinder are totally enclosed by a cylindrical mild-steel cover fixed at the top and bottom flanges of the cylinder. Between the shell and the cylinder and the cylinder cover rubber is packed to protect the water and air lines as well as the cylinder itself.

The grab carriage is located centrally in the shaft, while the trolley from which the grab-lifting cylinder is suspended has a horizontal travel of 4 ft. 6 in. starting from a point 4 ft. 11 in. from the axis. In conjunction with the rotary movement of the boom this arrangement enables a grab having a diameter of 7 ft. 6 in. when open to cover a circular area of 26 ft. in diameter. The total vertical lift is 17 ft. made up of a 10-ft. lift provided by the grab-lifting cylinder and a further independent lift of up to 7 ft. provided by the telescopic box cylinder operating the outer box.

All motions of the carriage and Cactus grab are controlled from a cockpit fixed to the bottom of the outer box. The air valve which controls the grab is operated by a foot pedal and the hydraulic valves are operated by the control box levers in the cockpit linked to the reversing valves by a hydraulic system. The hydraulic pressure pump, driven by a 50-h.p. air motor, is situated on the bottom of the stage and delivers 12,000 gal. per hour of fluid at a pressure of 300 lb. per sq. in. The pump and the various hydraulic cylinders are connected in closed circuit with a supply tank placed adjacent to the pump.

The approximate overall length of the carriage in its maximum lift position is 26 ft. measured from the end of the clevis connecting the grab-lifting cylinder and the grab to the top of the rotary gland. The portion protruding above the bottom deck of the stage measures approximately 10 ft. 6 in. All components of the grab carriage are readily changed or dismantled *in situ* and all internal operating mechanisms are accessible through inspection covers.

## Trade Paragraphs

**Triefus Industries, Ltd.**, of Manor Road, Crawley, Sussex, point out that the portable drill described and illustrated in the May issue is suitable for a hole size of  $1\frac{1}{8}$  in. with an  $1\frac{1}{8}$ -in. core.

**Richard Sutcliffe, Ltd.**, of Horbury, Wakefield, have received an order for the supply of equipment to handle 800 cu. yd. of overburden per hour at a new open-cast coal site in South Wales. It includes 12 48-in. wide, 80-h.p. conveyors, two multi-plate feeders, four 60-in. wide mobile conveyors, and three throw-off carriages and spreader conveyors.

**Thos. W. Ward, Ltd.**, of Sheffield, in a new illustrated publication describe a range of materials

handling equipment produced by their associated concern **Ensign Conveyor Co., Ltd.**, of Nottingham. Among the items listed are troughed belt-conveyors, unit construction conveyors, ground conveyors, feeders, elevators and hoists, and complete handling schemes.

**Westinghouse Brake and Signal Co., Ltd.**, of 82, York Way, King's Cross, London, N.1, have made new issues of a number of their pamphlets on mining equipment. These deal respectively with rams for decking and mine car and tippler loading, automatic gates for shafts, auxiliary valves for the remote control of air supply, skotch blocks for tubs with outside axle boxes, and the single-sided tub retarder.

**Ruston-  
Bucyrus  
150-RB  
Shovel**



**English Electric Co., Ltd.**, of Stafford, in a series of new illustrated publications cover such subjects as metalclad and oil-filled circuit breakers, control switches, indicating lamps, and current transformers.

**Mirrlees, Bickerton, and Day, Ltd.**, of Stockport—a member of the Hawker Siddeley Group—have obtained an order for their KVSS16 industrial diesel engine from the Ashanti Goldfields Corporation. The engine develops 4,128 b.h.p. at 428 r.p.m. and will be direct coupled to a Brush alternator giving 2,950 kW power output.

**Winston Electronics, Ltd.**, of Shepperton, Middx., to mark their appointment as the United Kingdom distributors of **Beckman Berkeley and Berkeley Helipot**, Richmond, California, electronic equipment for industry, staged a series of demonstrations at their works. A selection of the Berkeley equipment of interest to many phases of industry was shown, British, American, and German engineers explaining and demonstrating.

**Ross Engineers, Ltd.**, of 11, Walpole Road, Surbiton, Surrey, have recently produced a well-illustrated 42-page catalogue under the title "Material Handling with Ross." In an introductory note they point out that they have been called upon to deal with difficult material in every quarter of the globe. The booklet is conveniently divided into sections under the following headings: Complete handling plants, crushing plants, wagon handling systems, and equipment for feeding, screening, etc.

This last section covers chain feeders, drop-bar feeders, two-roll grizzlies, roll barriers, and wagon loading valves.

**LeTourneau-Westinghouse Co.**, of Peoria, Illinois, announce the addition to their line of an 11.5 cu. yd. scraper for use with tractors of 70 h.p. or more. The unit is designated as the DT Fullpak model. Design features and operational characteristics of the new DT are the same as on the other Fullpak models. It has a clean smooth bowl interior to minimize resistance in loading and unloading. The bowl floor which provides approximately 28 sq. ft. of load base measures only 40 in. from the tip edge of the cutting blade to the face of the tailgate, minimizing the distance material must travel to get into the bowl.

**Mechans, Ltd.**, of Scotstown Ironworks, Glasgow, in a 100-page fully-illustrated catalogue devoted to pipes, joints, valves, and other accessories include a section on tin-mining plant as supplied to Nigeria and other alluvial mining regions. This covers the paddock method and the use of gravel elevators, monitors, sluice-boxes, fluming, and, of course, piping. Two monitors described and illustrated are respectively of 7 in. and 12 in. diameter; one with hand swivelling lever and the other with an additional deflector at the nose which enables it to be turned more easily against water pressures. Two types of gravel elevators are also illustrated.

**Ericsson Telephones, Ltd.**, of High Church Street, New Basford, Nottingham, have published a complete catalogue and price list of their electronic and nucleonic instruments. This comprises batch counters, add-on counting equipment, interval timers, scaling units, G.M. counting equipment, probe unit for use with Geiger Muller tube, the field ratemeter type 1368A, the survey meter type 125A, the alpha-beta-gamma monitor type 145A, and various accessories. Both types of survey equipment have previously been described in the MAGAZINE.

**Ruston-Bucyrus, Ltd.**, of Lincoln, report that engineers from Yugoslavia interested in heavy-duty shovels for mining operations recently paid visits to various open-cast coal sites and to see the recently-introduced 150-RB Ruston-Bucyrus 6-cu. yd. shovel in operation at the Ox Bow site of the well-known contractors, Sir Lindsay Parkinson and Son, Ltd. The 150-RB, shown here in the maker's test yard, has an operating weight of 195 tons. The company also reports that among the important export orders they have received was one 110-RB Ward-Leonard electric quarry shovel for Carrieres et Fours at Chaux de la Meuse, Belgium. The machine has a working weight of 152 tons and a dipper capacity of  $\frac{1}{2}$  cu. yd. Other orders were two 38-RB  $\frac{1}{2}$ -cu yd. and one 22-RB  $\frac{3}{4}$ -cu. yd. excavators for the Maldiv Islands and four 22-RBs for Fiji.

**W. H. Allen Sons and Co., Ltd.**, of Bedford, announce that in connexion with a new tunnelling machine being developed by the National Coal Board's Central Engineering Establishment they have been awarded the contract for the epicyclic gear units. The gears are required for reducing the speed of the motors driving contra-rotating cutter heads. Four gears will be mounted on the machine, each designed to transmit 160 h.p. and capable of giving two alternative output speeds varying between 55 r.p.m. and 8 r.p.m. All four epicyclic gearboxes will be mounted within the scantlings of the machine which is approximately 18 ft. in diameter. The mechanical parts of the machine are being made by **Vickers-Armstrongs, Ltd.**, and the gear units will be manufactured at Atlas Works, Pershore, Worcs. Some parts of the control equipment were exhibited by **Bruce Peebles and Co., Ltd.**, of Edinburgh, on their stand at the recent Instruments, Electronics, and Automation Exhibition in London.

**Gresham Transformers, Ltd.**, of Hanworth, Middx., on the occasion of the recent opening of a new heavy assembly bay, demonstrated a wide range of their products, including a series of mobile substations designed for use underground. Generally constructed in accordance with N.C.B. specifications P108 and P109 these have ratings of 100, 150, 200, 250, and 300 kVA for 3-phase supply. Those made to specification P108 are for voltages of 2,000-2,200, 2,600-2,900, or 3,000-3,300 and give a secondary voltage of 600 with a full load tapping at 475 V. Those made to specification P109 have the primary wound for 3,300 V and the secondary for 565 V. Voltage adjustment may be effected by an externally operated off-circuit tapping switch or by links at cold oil level. In the latter case a detachable panel permits access without the necessity for removing the complete tank cover. Earth leakage protection is incorporated in the switchgear, and flameproof circuit breakers and/or flameproof flit plugs and adaptors are mounted on flanges which conform to N.C.B. Standard No. 4500/8. The company also

gives particulars of a special transformer made to the special requirements of the National Coal Board of 2,000 kVA rating, the input being 11,000 V and output 3,300 V. For this, on-load hand-operated tap-changing mechanism provides 1½% voltage steps ranging from -10% to +5% on the high-voltage side.

**British Ropes, Ltd.**, of Doncaster, have lately issued two new publications. In the first (No. 147) the four revised British Standards for mining and engineering ropes are fully explained. The introduction of these standards has inevitably brought changes in specifications, it is pointed out, and sizes and constructions have been rationalized by the introduction of grouping systems, designations modified, and sizes given in diameters instead of circumferences as hitherto. The publication will assist every rope user in the ordering of wire rope for mine-winding and haulage, cranes, excavators, and hoists. The company have also taken the opportunity to produce the thirteenth edition of its well-known blue pocket catalogue (Publication No. 74). This has been completely revised in accordance with the current British Standards and also includes similar information for all classes of locked coil ropes. In addition to many pages of breaking strength tables this handy little publication includes data regarding elementary maintenance fittings and official regulations. Some particulars have also been released of the new company jointly formed by British Ropes, Ltd., and a Mexican industrialist Ing. G. Saavedra, the factory having just delivered its first 16,000 metres of wire rope and now in production on a two-shift basis. The company is called Cables Mexicanos S.A. de C.V. and it promises to be a successful enterprise—a product of Anglo-Mexican co-operation and British engineering skill.

**Motor Rail, Ltd.**, of Bedford, announce an addition to their range of "Simplex" narrow-gauge diesel locomotives. Built in 2½-ton, 3½-ton, and 4½-ton weights, this new 30-h.p. model supersedes the 28-h.p. series, having greater power and a higher speed range. The Dorman 2 LB engine is a direct-injection two-cylinder unit with overhead valves, 125 mm. bore, 130 mm. stroke. Particular attention is paid to thorough filtration of oil and air, increasing its efficiency in dusty conditions. Engine speeds are governed from idling (380 r.p.m.) to maximum (1,800 r.p.m.) at which speed it develops



35 b.h.p. The cooling system has a detachable tube radiator, so designed that each tube can be removed for repair or replacement. The engine, clutch, and gearbox are mounted transversely in the centre of and parallel to the driving axles, giving a lower centre of gravity and greater safety, especially on uneven track. The gearbox provides for two speeds in either direction, the speed change gears lie in constant mesh, and the box is fully enclosed and dustproof. A feature of the new locomotive is the lever-operated brake system, full braking being applied almost instantaneously on all four wheels. Average fuel consumption works out at 2 gallons to 3 gallons per 8 hour day. Available for gauges of 1 ft. 6 in. to 2 ft. 6 in. and 2 ft. 11 in. to 3 ft. 3½ in., the locomotive will negotiate curves as low as 18 ft. radius although as a rule loads should not be hauled on curves of less than 30 ft. radius. Because of its compact size it is very suitable for mine work and exhaust quenchers can be supplied. In low gear the 2½-ton locomotive delivers a tractive effort of 1,250 lb., the 3½-ton 1,750 lb., and the 4½-ton 2,250 lb.

### RECENT PATENTS PUBLISHED

A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

**30,028 of 1954 (797,832).** A. E. PRUDHOMME AND A. W. DEVELEY. Preparation of alkaline earth metals.

**37,809 of 1954 (797,428).** VEREIN. ALUMINIUM-WERKE A.-G. Plant for carrying out fusion electrolysis.

**5,748 of 1955 (798,294).** H. BURGGRAF. Lumping of primarily fine-grain materials.

**9,595 of 1955 (798,750).** DOMINION MAGNESIUM INC. Production of titanium.

**10,875 of 1955 (797,758).** SIMON-CARVES, LTD. Magnetic separation of material carried in liquids or slurries.

**17,387 of 1955 (798,478).** CHEMICAL CONSTRUCTION CORPORATION. Hydrometallurgical production of nickel and cobalt.

**22,619 of 1955 (797,689).** HORIZONS TITANIUM CORPORATION. Purification of titanium or zirconium.

**22,631 of 1955 (797,440).** COAL INDUSTRY (PATENTS), LTD. Dust suppression units.

**22,766 of 1955 (797,607).** CHEMICAL CONSTRUCTION CORPORATION. Leaching non-ferrous metals from ores containing metalloids.

**28,560 of 1955 (797,694).** METALLGES. A.-G. Pelletization and conveying mechanically-sensitive or fine-grain material.

**35,389 of 1955 (798,100).** DORR-OLIVER INC. Continuous automatic wet-grinding process.

**992 of 1956 (797,616).** ELTRO GES. AND CO. Production of titanium metal and alloys.

**10,333 of 1956 (797,854).** PECHINEY CO. DE PRODUITS CHIMIQUES ET ELECTROMETALLURGIQUES. Production of calcium.

**10,572 and 32,461 of 1956 (797,622, 798,287).** KLÖCKNER-HUMBOLDT-DEUTZ, A.-G. Vibrating machine for conveying, grading, or screening.

**17,524 of 1956 (797,501).** SOC. ANON. POUR L'INDUSTRIE DE L'ALUMINIUM. Electrolytic recovery of metallic gallium.

**37,059 of 1956 (798,768).** KENNECOTT COPPER CORPORATION. Froth flotation concentration of niobium minerals.

### NEW BOOKS, PAMPHLETS, ETC.

Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

**Gypsum and Anhydrite.** By Dr. A. W. GROVES, Overseas Geological Surveys, Mineral Resources Division. Paper covers, 108 pages. Price 7s. 6d. London: H.M. Stationery Office.

**Die Blei-Zink-Erzgänge des Schwarzwaldes:** Monographs of the German Lead-Zinc Occurrences, No. 14. By R. METZ, M. RICHTER, and H. SCHÜRENBURG. Paper covers, 275 pages, illustrated, with 15 plates and maps. Price 40 DM., Clausthal-Zellerfeld: Ges. Deutscher Metallhütten und Bergleute e.V.

**Blasting in Collieries.** Third edition, 1958. Paper covers, 44 pages, illustrated. Glasgow: Imperial Chemical Industries, Ltd., Nobel Division.

**Selected Annotated Bibliography of Asbestos Resources in the United States and Canada:** U.S. Geol. Survey Bulletin 1019—L. Paper covers, pp. 817-865. Price 25 cents. Washington: Superintendent of Documents.

**Non-Ferrous Metals and Ferroalloys** (Metalli Non Ferrosi e Ferroleghe): Statistics, 1957. Paper covers, 138 pages. Rome: Azianda Minerali Metallici Italiani (A.M.M.I.).

**Yukon Territory:** Geological Survey of Canada Memoir 284. Selected Field Reports, 1898 to 1933, compiled and annotated by H. S. Bostock. Paper covers, 650 pages, with maps. Price \$3-00. Ottawa: Department of Mines and Technical Surveys.

**Geological Society of South Africa: Transactions and Proceedings,** Jan.-Dec., 1957. Paper covers, xcix + 197 pages, - illustrated. Johannesburg: Hortors, Ltd.

**Ghana:** Report of the Mines Department, April 1, 1956-March 31, 1957. Paper folio, 22 pages. Price 2s. 6d. London: Crown Agents for Overseas Governments and Administrations.

**Sierra Leone:** Report of the Mines Department, 1956. Paper covers, 15 pages. Price 1s. 6d. London: Crown Agents for Overseas Governments and Administrations.

## Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

\* Article in the present issue of the MAGAZINE.

† Article digested in the MAGAZINE.

### Economics

**Diamonds, Artificial :** *Manufacture, Properties.* Man-Made Industrial Diamonds. J. D. KENNEDY, *Precambrian*, June, 1958.

**Gasification, Coal :** *Progress, Review.* Recent Development in Underground Gasification. C. A. MASTERMAN, *Trans. Instn. Min. Eng.*, Aug., 1958.

**Mineral, United States :** *Sand and Gravel, California.* Sand and Gravel Resources of Cache Creek. I. E. KLEIN, H. B. GOLDMAN, *Calif. J. Min. Geol.*, Apr., 1958.

**Production, Africa :** *Manganese, South.* Manganese from South Africa Plays Big Role in Building U.S. S. Afr. Min. Engg. J., June 20, 1958.

**Production, United States :** *Uranium, New Mexico.* U<sub>3</sub>O<sub>8</sub> Production Now Under Way at Ambrosia Lake District. J. B. HUTTL, *Engg. Min. J.*, July, 1958.

**Resources, New Zealand :** *Sands, Iron.* New Zealand Iron Sands. *Chem. Engg. Min. Rev.* (Melbourne), May 15, 1958.

**Taxation, Mine :** *Allowances, United States.* It May Pay to Check Past Percentage Depletion Calculations. F. H. MADISON, *Engg. Min. J.*, July, 1958.

**Uranium, United States :** *Costs, Mining.* Continental Reviews Three Phases of Uranium Mining. J. G. ROSCOE, M. H. BRADY, *Min. Engg.*, July, 1958.

### Geology

**\*Economic, Rare Metals :** *Occurrences, Carbonatite.* Rare Metals in Carbonatites. THE MINING MAGAZINE, Aug., 1958.

**Economic, United States :** *Magnetite, New Jersey.* Geology and Magnetite Deposits of Dover District, Morris County, New Jersey. P. K. SIMS, *U.S. Geol. Surv. Prof. Paper* 287.

**Economic, United States :** *Uranium, Montana.* Uranium in Carbonaceous Rocks in the Townsend and Helena Valleys, Montana. G. E. BECRAFT, *U.S. Geol. Surv. Bull.* 1046-G.

**Mineralogy, Asbestos :** *Studies, X-Ray.* Identification of Minerals Associated with Asbestos by X-Ray Diffraction Patterns. M. S. BADOLLET, J. P. MCGOURTY, *Canad. Min. Metall. Bull.*, June, 1958.

**Regional, Africa :** *Valley, Zambezi.* The Development of the Mid-Zambezi Valley in Northern Rhodesia Since Early Karroo Times. R. TAVENER-SMITH, *Geol. Mag.*, Mar.-Apr., 1958.

**Regional, Canada :** *Survey, Nova Scotia.* Mississippian Stratigraphy and Petroleum Possibilities of Central Cape Breton Island, N.S. D. G. KELLEY, *Canad. Min. Metall. Bull.*, June, 1958.

**Survey, Geochemistry :** *Sampling, Soil.* Field Procedures and Costs in Soil Sampling. W. J. BICHAN, *Canad. Min. J.*, June, 1958.

**Survey, Geochemistry :** *Tests, Soil.* Significance of Geochemical Distribution Trends in Soil. D. H. YARDLEY, *Min. Engg.*, July, 1958.

**Survey, Geophysics :** *Aeromagnetic, Canada.* Geologic Aeromagnetic Correlation in Eastern Townships, Quebec. A. S. MACLAREN, A. LAROCHELLE, *Canad. Min. J.*, July, 1958.

**Survey, Topographic :** *Use, Tellurometer.* First-Order Traversing with the Tellurometer. G. I. HUMPHRIES, H. H. BRAZIER, *Emp. Surv. Rev.*, July, 1958.

### Metallurgy

**Copper, Sulphide :** *Decomposition, Electrolytic.* The Production of Copper and Sulphur by the Electro-Decomposition of Cuprous Sulphide. T. P. HOAR, R. G. WARD, *Bull. Instn. Min. Metall.*, May, 1958.

**Hydrometallurgy, Leaching :** *Decantation, Counter-Current.* Graphical Representation of Theoretical Soluble Losses by CCD. R. J. WOODY, *Min. Engg.*, July, 1958.

**\*Hydrometallurgy, Uranium :** *Extraction, Liquid Solvent.* Solvent Extraction of Uranium. THE MINING MAGAZINE, Aug., 1958.

**Hydrometallurgy, Uranium :** *Plant, United States.* U<sub>3</sub>O<sub>8</sub> Production Now Under Way at Ambrosia Lake District. J. B. HUTTL *Engg. Min. J.*, July, 1958.

**Roasting, Sulphide :** *Compacts, Powder.* The Oxidation of Powder Compacts of Copper-Iron Sulphides. T. A. HENDERSON, *Bull. Instn. Min. Metall.*, July, 1958.

**Roasting, Sulphide :** *Ore, Lump.* The Oxidation Rates of Lump Copper-Iron Sulphides. T. A. HENDERSON, *Bull. Instn. Min. Metall.*, June, 1958.

**Steel, United States :** *Industry, California.* Industrial Minerals Used in California's Iron and Steel Industry. K. M. MOTE, *Min. Engg.*, July, 1958.

**Uranium, Extraction :** *Ores, Blending.* (1) Engineered Blending of Uranium Ores (E. T. WOOD). (2) Another View of Blending (S. E. CRAIG). *Min. Engg.*, July, 1958.

**Uranium, General :** *Studies, United States.* Uranium Milling Technology. S. W. F. PATCHING, *Mine, Quarry Engg.*, Aug., 1958.

## Machines, Materials

**Aluminium, Structural :** *Behaviour, Corrosion.* The Corrosion Behaviour of Aluminium in the Construction Industry. J. F. WHITING, H. P. GODARD, *Engg. J.*, June, 1958.

**Belts, Conveyor :** *Care, Maintenance.* New Life for Damaged Conveyor Belts. *Engg. Min. J.*, July, 1958.

**Clam-Shell, Sinking :** *Operation, Air.* Air-Operated Clamshell for Sinking Small Shafts. J. W. LOWER, *Min. Engg.*, July, 1958.

**Conveyor, Belt :** *Duty, Study.* Relating a Roadway Belt Conveyor to Its Duty. *Inf. Bull. N.C.B.* No. 58/197.

**Fans, Ventilating :** *Uses, Selection.* Selection of Mine Ventilating Fans. L. WALTER, *Canad. Min. J.*, July, 1958.

**Hoists, Winding :** *Conversion, Canada.* Electrification of Three Large Hoists at Dominion Coal Co., Ltd. J. A. RUSSELL, *Canad. Min. Metall. Bull.*, June, 1958.

**\*Noise, Rock-Drill :** *Consumption, Energy.* Energy Consumed by Rock-Drill Noise. J. HOLDO, *THE MINING MAGAZINE*, Aug., 1958.

**Ploughs, Coal :** *Design, Application.* Coal Ploughs and Their Application. P. WILLIAMS, *Coll. Engg.*, Aug., 1958.

**†Screens, Heated :** *Applications, United Kingdom.* Heated Screens. *Mining Digest, THE MINING MAGAZINE*, Aug., 1958.

**Steel, Protecting :** *Applications, Mine.* Flame-Priming of Steel Surfaces in Mine Applications. G. H. MORGAN, *Canad. Min. J.*, July, 1958.

## Mining

**Breaking, Blasting :** *Tunnels, Studies.* Drilling and Blasting Long Rounds in Tunnels. J. S. BARKER, *Mine, Quarry Engg.*, July, Aug., 1958.

**Breaking, Drilling :** *Piercing, Jet.* Jet Piercing—the Miner's Rocket. L. E. ANTONIDES, *Engg. Min. J.*, July, 1958.

**Costs, Operating :** *Review, Rhodesia.* Cutting Costs in Rhodesian Mines. R. A. MATHERS, *Chem. Engg. Min. Rev.* (Melbourne), June 16, 1958.

**Drilling, Diamond :** *Performance, Bit.* Diamond Bit Performance in Quartzite (A. J. RAMBOSEK, A. E. LONG). Diamond Bit Performance in Cherty Limestone and Cherty Dolomite (G. H. JOHNSON, A. E. LONG). *Repts. Inv. U.S. Bur. Min.* 5402-3.

**Driving, Incline :** *Coal, United Kingdom.* Drifting at Goldthorpe. *Coll. Engg.*, Aug., 1958.

**\*Education, Germany :** *Conference, Eastern.* Conference in Freiberg. H. L. HOLLOWAY, *THE MINING MAGAZINE*, Aug., 1958.

**General, South Africa :** *Progress, Review.* Trends in Development Practice in South Africa in the Past Ten Years. D. M. JAMIESON, *J. S. Afr. Inst. Min. Metall.*, June, 1958.

**General, United Kingdom :** *Gypsum, Sussex.* Mountfield Sub-Wealden Gypsum Mine. W. S. GIBSON, *Mine, Quarry Engg.*, Aug., 1958.

**Handling, General :** *Practice, Sweden.* Some Automatic Devices at Boliden for Hauling, Hoisting, Surface Transport. S. ANDO, *Canad. Min. J.*, June, 1958.

**Hazards, Health :** *Uranium, United States.* Engineering Control of Health and Safety Hazards in Uranium Mines. J. WESTFIELD and others, *Inf. Circ. U.S. Bur. Min.* 7834.

**Models, Construction :** *Design, Canada.* Lightweight Models of Mining Methods. H. R. RICE, *Canad. Min. J.*, July, 1958.

**Movements, Ground :** *Studies, European.* Considerations on Ground Movement Phenomena. H. FLÄSCHENTRÄGER, *Coll. Engg.*, Aug., 1958.

**†Open-Cast, South Africa :** *Diamonds, South-West.* Earth-Moving in the Diamond Mines of Southern Africa. C. P. A. LOUWENS, *J. S. Afr. Inst. Min. Metall.*, June, 1958.

**Sinking, Shaft :** *Gold, South Africa.* Shaft Sinking at Free State Saaiplaas Gold Mining Co., Ltd. G. A. MERRICKS, M. H. THOMPSON, *J. S. Afr. Inst. Min. Metall.*, June, 1958.

**†Sinking, Shaft :** *Mucker, Mechanical.* Shaft-Sinking Grab Carriage at Hartebeestfontein. *S. Afr. Min. Engg. J.*, June 20, 1958.

**Strength, Formation :** *Floors, Mine.* Some Investigations into the Bearing Capacities of Floors in the Northumberland and Durham Coalfield. J. D. JENKINS, *Trans. Instn. Min. Eng.*, Aug., 1958.

**Support, Ground :** *Arches, Yielding.* Roadway Supports, with Special Reference to Yielding Arches. H. CUNLIFFE, A. G. JOHNSTON, *Trans. Instn. Min. Eng.*, Aug., 1958.

## Ore-Dressing

**\*Comminution, Grinding :** *Media, Sizes.* Size of Grinding Media. Ore-Dressing Notes, *THE MINING MAGAZINE*, Aug., 1958.

**Flotation, Cells :** *Aeration, Study.* Improved Method of Measuring Aeration in Flotation Cells. J. B. GAYLE, *Min. Engg.*, July, 1958.

**Flotation, Non-Metallic :** *Coatings, Slime.* Iron Oxide Slime Coatings in Flotation. D. W. FUERSTENAU and others, *Min. Engg.*, July, 1958.

**†Flotation, Non-Metallic :** *Fluorite, Review.* The Flotation of Fluorite. W. J. TRAHAR, C.S.I.R.O. Information Circular No. 4.

**Gravity, Cyclones :** *Separation, Slime.* Better Cycloning in Sand-Slime Separation. R. L. CURFMAN, *Min. Engg.*, July, 1958.

**Gravity, Sink-Float :** *Ores, Iron.* Distribution Curves for Sink-and-Float Separation of Iron Ores. R. G. WUERKER, *Min. Engg.*, July, 1958.

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Slime. Iron  
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of Iron Ores.  
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